21 APRIL 1960

ONE SHILLING
AND SIXPENCE

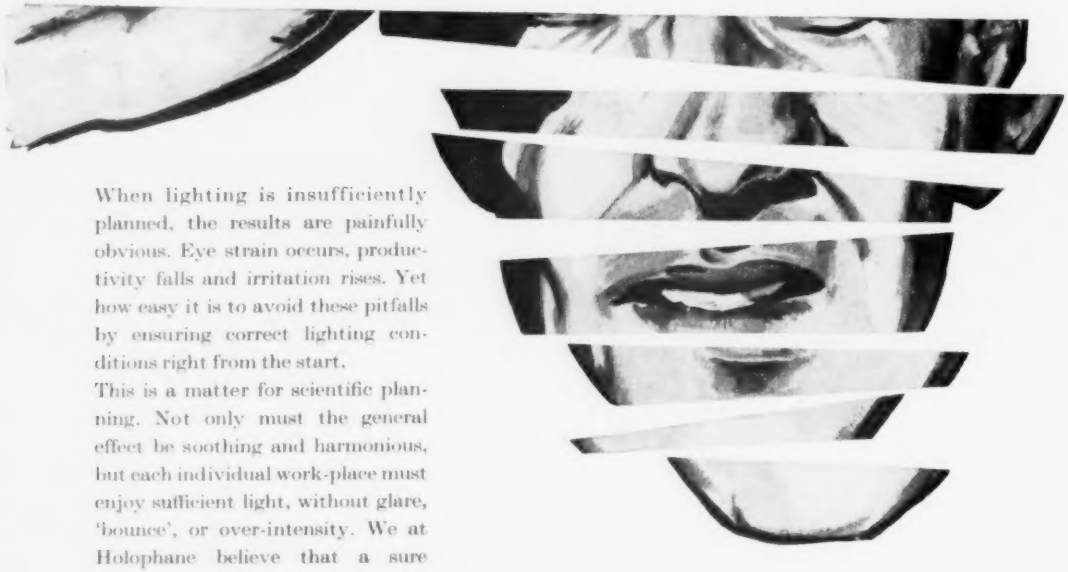
ELECTRICAL TIMES

BICC CABLES

for all wiring installations

BRITISH INSULATED CALLENDER'S CABLES LIMITED 21 BLOOMSBURY STREET LONDON WC1

HAS SOMEONE MADE A GLARING MISTAKE HERE?



When lighting is insufficiently planned, the results are painfully obvious. Eye strain occurs, productivity falls and irritation rises. Yet how easy it is to avoid these pitfalls by ensuring correct lighting conditions right from the start.

This is a matter for scientific planning. Not only must the general effect be soothing and harmonious, but each individual work-place must enjoy sufficient light, without glare, 'bounce', or over-intensity. We at Holophane believe that a sure remedy for these ills is . . . *scientific control*—an aspect of lighting which has occupied our engineers and research staff for upwards of sixty years.

If you would like details of how our unique prismatic reflectors and refractors can contribute to productivity, cheerfulness and general goodwill in any establishment, why not get in touch with us by letter or telephone right away?

HOLOPHANE

SCIENTIFICALLY CONTROLLED LIGHTING

HOLOPHANE LIMITED ELVERTON STREET
WESTMINSTER · LONDON S.W.1 · Telephone: VICtoria 8062

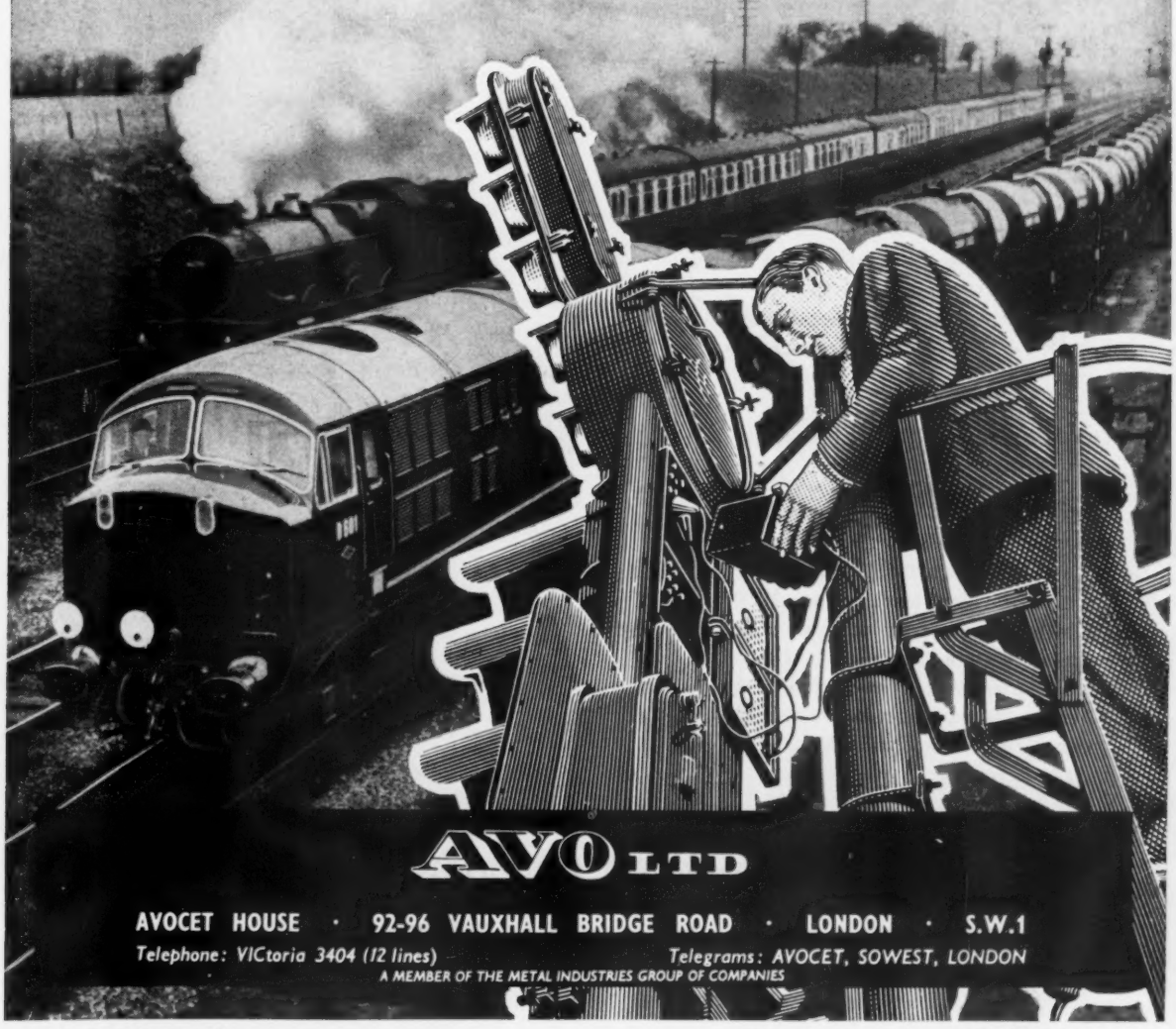
AVO INSTRUMENTATION

AVO instruments are in the service of British Railways and transport and industrial undertakings throughout the world.

AVO

Regd. Trade Mark

Multi-range Testmeters
Valve Voltmeters
Valve Testers
and other electronic instruments



AVO LTD

AVOCET HOUSE · 92-96 VAUXHALL BRIDGE ROAD · LONDON · S.W.1

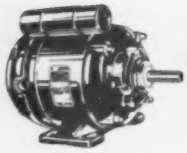
Telephone: VICtoria 3404 (12 lines) Telegrams: AVOCET, SOWEST, LONDON

A MEMBER OF THE METAL INDUSTRIES GROUP OF COMPANIES

An Esso photograph

Illustration by courtesy of British Railways

G24



THEY ALL CHOSE AEI FRACTIONALS

I wanted a 'fractional' with auto-belt tension adjuster...

I wanted a special low-speed geared motor...

I wanted a 'fractional' with horizontal spigot mounting...

Whatever the project, if you are producing machinery to be powered by a.c. or d.c. motors of up to one h.p., consult AEI engineers at the design stage. The wide choice of fractionals they can offer gives you greater scope for producing machinery of improved design and performance. AEI experts have almost certainly met problems similar to yours already, and their valuable experience and knowledge are at your service.

OUR ADVISORY SERVICE FOR DESIGNERS

will save you time and money!

Consult AEI engineers *at an early stage* and make sure of getting the *right* f.h.p. motor for the job! Many types and sizes from 1/500 h.p. are available, with every conceivable kind of mounting or fitting, and many of these are available from stock. You can thus combine maximum efficiency and reliability with the most compact, practical, and attractive design.

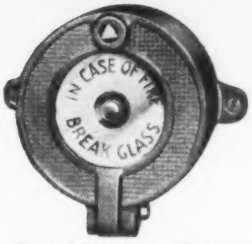
AEI

Associated Electrical Industries Limited
Motor and Control Gear Division
F.H.P. MACHINES SALES
NEWCASTLE, STAFFORDSHIRE, ENGLAND

B T-H *INCORPORATING THE MOTOR AND CONTROL GEAR INTERESTS OF BTH AND M-V* A 5395'

Fire

Contractors—this is **your** business! **Profitable business** can be obtained by installing Gents' Fire Alarm Systems. Efficient, reliable and economical, simple systems are easily installed which comply with the Factory Act. Where necessary the free services of our Technical experts are available for surveying the premises.



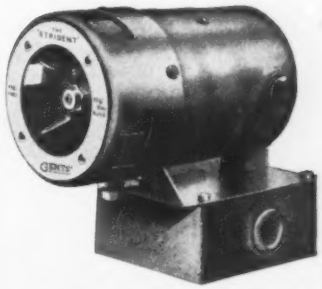
Typical Fire Alarm Contact

Specially designed as a neat, small Fire Alarm Point, with precious metal contacts and substantial springs for **complete** reliability even after years of installation. Each contact will operate a maximum of 3 Strident syrens on 200/250v AC.

PRICE £2. 10s. 0d.

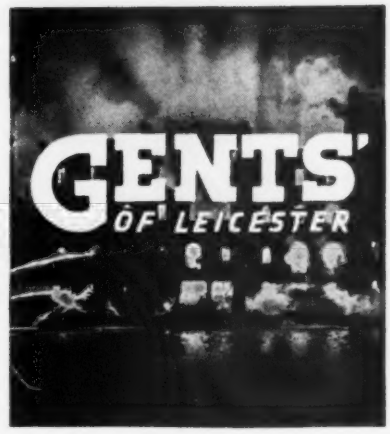
The "Strident" syren is ideal as a Fire Alarm signal and overcomes most noise levels. Only takes ¾ amp with consequent saving in wiring and current consumption. Totally enclosed motor for indoor use only, continuously rated. Base box drilled for ¾" conduit fitted with knockouts and can be turned through 90° to conform to conduit run.

PRICE 200/250 volts AC/DC (¾ amp consumption) **£7. 0. 0.**
24 volts DC (2 amp consumption)



The "STRIDENT" Syren

Alarms



Our informative booklet "Are You Protected?" *will give you further information on installing Gents' Fire Alarm Systems together with sample schemes. Write for your free copy without delay.*

FIRE ALARM SYSTEMS

GENT & COMPANY LTD · FARADAY WORKS · LEICESTER

London Office & Showroom : 47 Victoria Street, London S.W.1.

Branches also at: BELFAST
BIRMINGHAM
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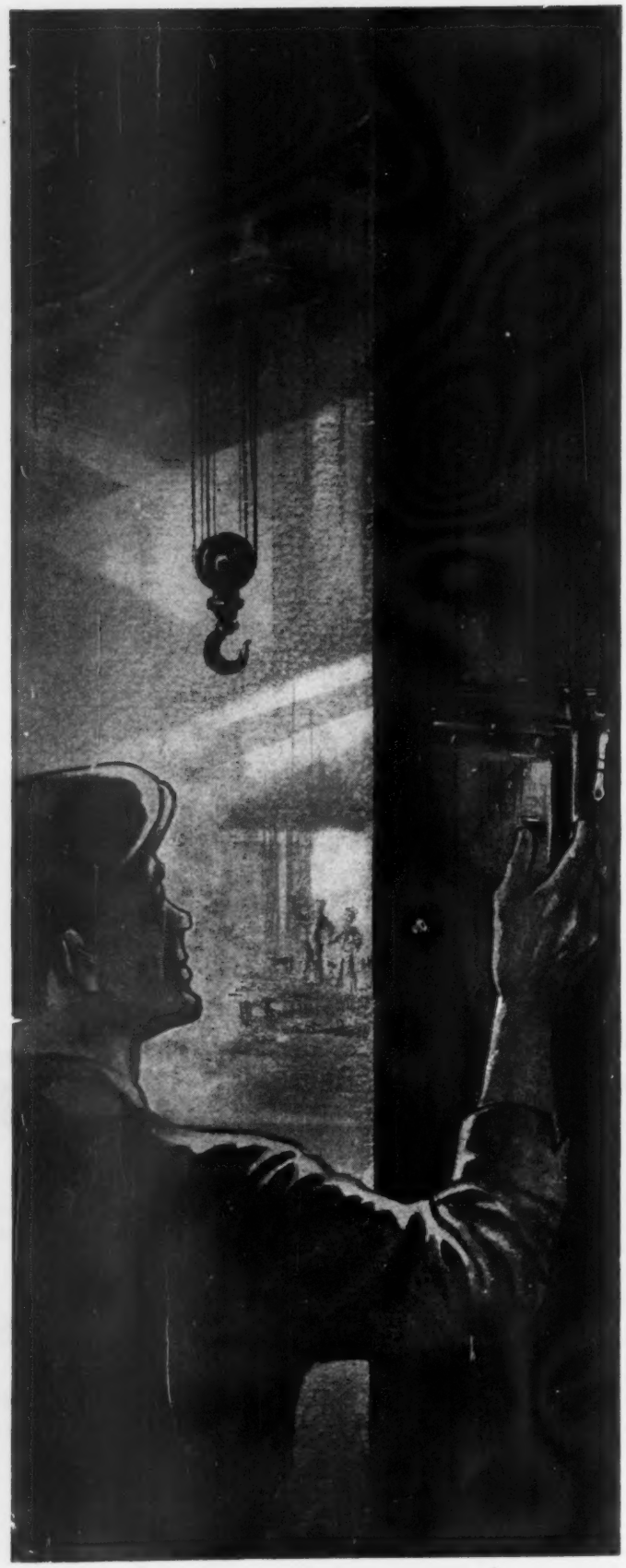

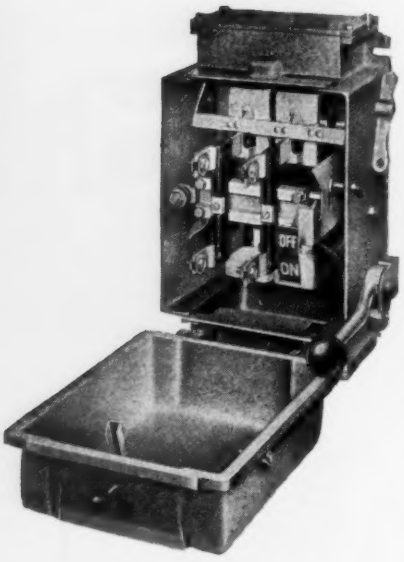

The "Sandaclad"

ISOEARTH

for SAFETY

The ISOEARTH is the well-proved "Sandaclad" Fuse Switch incorporating a simple device enabling the main control switch to be locked in the 'off' position, and at the same time earthing the outgoing conductors, thus implementing the recommendation of H.M. Electrical Inspector for safety when working on or near to trolley wires, exposed conductors, etc.

Details of this Switch and full range of other competitively priced products in new Catalogue 158/59.

Make sure you have a copy!

SANDERS
WEDNESBURY

The mark of superiority in Switch and Fusegear

WM. SANDERS & CO. (WEDNESBURY) LTD.
FALCON ELECTRICAL WORKS,
WEDNESBURY, STAFFS.

NEVER FORGET

WOOTTON

METER BOARDS ARE BEST!

Here's a trunk call coming through for all meter board users: "Wootton tested boards are extra tough, and combine strength plus reliability under all climatic conditions"—and don't forget WOOTTON wood blocks, sunk switch boxes and instrument cases.

WOOTTON & CO. LTD.,
ALMA WORKS, PONDERS END,
MIDDLESEX

Telephone: HOWard 1858

Announcing the New

THERMODARE

Embedded-Rewireable

UNDERFLOOR HEATING

at a price which makes solid-in systems a thing of the past

The completely new Thermodare Underfloor Heating system offers all the advantages of a rewireable installation yet costs little more than the solid-in systems. This very low cost, combined with free accessibility makes the Thermodare *embedded-rewireable* system the automatic choice for today's underfloor installations. Thermodare have many years of experience as heating engineers, and offer complete technical services. The time to call in Thermodare consultants is in the earliest days of the planning stage. Take full advantage of this free service. For full details of the whole Thermodare range of Heating equipment—Night Storage Heaters, Infra-Red Heating and the new Thermodare Underfloor Heating—please write your name and address on this advertisement and send it to the address below.

NAME .....

ADDRESS .....

THERMODARE

THERMODARE (GREAT BRITAIN), YORK MANSION, 94/98 PETTY FRANCE, LONDON, S.W.1
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E.T.2

1912-1960

Electrical Times, 21 April, 1960

THE STORY OF

BELLING & COMPANY LIMITED

Annual Report of the Governing Director No. 37. MARCH 1960

I AM WRITING my Annual report on the high seas between Melbourne and Fremantle, of course with the aid of wireless and frequent reports and figures from home by air mail, which in these days reach Australia about four days after posting.

I am glad to say that, as indicated in my last half-yearly report, things have gone well, and that for the year ending March 31st, 1960, our Sales this time are 20% up on last year, making still another record. Our profit has remained about the same, but we have economies still to come from further new plant recently installed. In these circumstances I am glad to be able to make another distribution of a share of our profits to all employees, on the same basis, and at the same figure per "point", as last year. This will amount to about £170,000 for the year, bringing the total sum now distributed to employees, over the last twelve years since the scheme was started, to just about £1,000,000.

In addition to largely owning their own houses, most of our older employees have the very latest electrical equipment in their homes, with motor cars and television sets as part and parcel of their normal standard of living. This of course is all to the good.

It has just struck me that this report may seem rather strange to any members of the public who may happen to read it, so I ought to explain that this is still a private Limited Company and the report is primarily written to keep our employees and our customers right up to date with our progress and our results, and also of course our programmes for the future. The report is published in the Electrical Press, and the local papers both at Enfield and Burnley, and also each of our employees has a copy given direct.

As I have now used up a considerable amount of space with this explanation, I am afraid I shall have to condense the rest of this Annual report, so had better do so under headings.

Production and Sales. 20% up on last year.

Profit. About the same as last year, indicating a lower percentage for the present. This is mainly due to full efficiency not yet having been reached, following the recent introduction of new cookers. The situation is however improving daily.

Full employment. We now have over 3,000 employees at the two works, and have maintained full employment over the whole year.

Enfield extensions. Our new 60,000 sq. ft. building is now actually started, and we hope for completion in the Autumn. We have also a completely new front building in view. This would give us much more space for administration, research and development and additional storage, and perhaps above all will make an imposing front to the works, and add to the appearance and importance of Southbury Road where our works are situated. Total area of land ten acres.

Extensions at Burnley. Our second 100,000 sq. ft. building is completed and in full production. We have also recently bought another 100,000 sq. ft. factory which actually adjoins our property. This we have already moved into, and it will be used for producing and storing the fires we make during the summer months. It will be a great asset as it leaves our other two buildings all clear for production. Shortly we shall start levelling the site for a third building which we hope to complete this year. When finished we shall thus have four buildings each of 100,000 square feet, and another twenty acres of land still available for expansion up there. Total area of land thirty-seven acres.

Scottish storage centre. Purchase of land is now completed. Fencing and levelling and draining are being dealt with. Eight acres.

Midland storage centre. The same comments apply here. We have as yet done no actual building—simply preparations. Fifteen acres.

Fire production and sales. We have had a splendid season with a big increase in demand. Burnley are doing a fine job in production, and we have considerably increased our programme for season 1960/61.

Cooker production. Here again, we have had a wonderful year and Enfield deserve the highest praise for their efforts and results, bearing in mind the difficulties involved in introducing new models. Also I must pay tribute to the extraordinary support we have had from our customers during this period. Everyone—works, sales, development, and myself personally, cannot really fully express our appreciation for your co-operation, but we are really grateful.

Our two new Cookers the 48 and the 59 are now running through quite smoothly, and all reports are good. We have also recently introduced our Nos. 60 and 70 models with four boiling plates. These have been shown at the Ideal Home Exhibition at Olympia and have created a great deal of public interest. Incidentally, the ever popular 47AB still holds its own, and looks like doing so for many years to come. Every electrician knows it inside out, and it is so absolutely reliable and simple, that it just won't be stopped. It has given twelve years of wonderful cooking results.

Development and Research. This Department has been considerably increased recently, but most unfortunately Mr. Panisset who rejoined us in October passed away a short while back, before he could get really going. This was most sad and unexpected. We were all extremely upset, and also about the death of Mr. Prince who was our employee with the longest service—forty-six years.

Our present programme. We are always at work on new fires and new cookers, and also on certain new electrical appliances. For the moment production is however concentrated on our two main lines, namely Fires and Cookers, and our object is to keep well ahead in these sections by specializing in them, rather than trying to introduce some completely new types of appliances.

Export. I am sorry to have to report that this is still difficult. The recent removal of restrictions of imports into Australia may help a little, but local manufacturers are by now fairly well established, and naturally official quarters give preference to "home-made" goods. Exports seem to depend very largely now on politics rather than anything else.

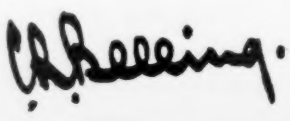
Advertising. We propose expanding this still further, much on its present basis, that is, space in local weekly papers, in certain provincial dailies, in some national dailies, and in selected "Home" and women's magazines.

Catalogues. Our last catalogue was very popular. We went back to the "pocket" size, and we propose using this size again for the coming issue of 1960/61.

Prospects for the coming year. We think business will remain good as long as present conditions continue and we are making our plans accordingly. Serious inflation or a reduction in house building would of course alter matters as far as we are concerned.

We are setting our sights at a target increase of 25% for this coming year, which we hope, with your help, we may be able to attain.

Just two more years now to complete my fifty years in business, and what wonderful help I have had from everyone, and what a time we will have on this occasion!



Belling & Co. Ltd., Bridge Works, Enfield, Middx. HOWard 1212

MULTI-RANGE

the most versatile system of fluorescent lighting!

240 DIFFERENT INDUSTRIAL AND COMMERCIAL FITTINGS BUILT AROUND ONE STANDARD SPINE *

* SEND FOR OUR 1960 CATALOGUE

fluorescent MORLITE lighting

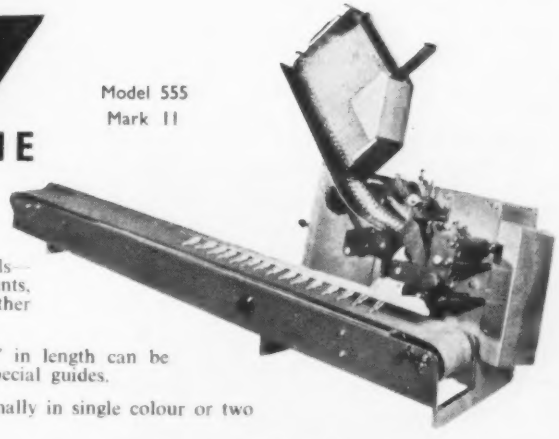
One standard channel unit, housing single or twin control gear, suspension and all wiring, can be used in conjunction with a large variety of Industrial Commercial and Decorative Reflectors or diffusers.
Easy to buy . . . . easy to service . . . . easy to fix . . . . easy to modify at any time after installation.

MORLEY'S ELECTRICAL SERVICES (HOLLOWAY) LTD.
117 Hornsey Road, London, N.7. Telephone North 5008 (4 lines)

HIGH-SPEED PRINTING

WITH THE **REJAFIX** ROTARY PRINTING MACHINE

Model 555
Mark II



- Fully automatic, for marking and printing of cylindrical articles—either straight sided or slightly tapered.
- Printing on articles made of many different materials—suitable for Glass ampoules, Vials, Electrical components, Cosmetic products, Pen or pencil barrels, many other articles.
- Any diameter from $\frac{3}{16}$" up to $1\frac{1}{4}$". Articles up to 5" in length can be printed on standard machine, longer with the aid of special guides.
- Direct printing with rubber stereos is used. Prints normally in single colour or two colours side by side but not intermingled.
- Output up to 7,000 per hour, small articles up to $\frac{1}{2}$" in diameter 12,000 per hour according to shape and size.

REJAFIX LIMITED 81-83 FULHAM HIGH STREET, LONDON, S.W.6
Telephone: RENown 5802, 5803 and 5804

Power Costs Effectively Reduced—by HUNTS CAPACITORS

This Hunts Therminol Capacitor Bank for Power Factor Improvement was exhibited at the Electrical Engineers Exhibition.

Specification
950 kVAr 380 volts
3 Phase 50 cycles
Assembled with HRC fused Therminol capacitor units of 25 kVAr

Conditions vary between different areas and from one type of installation to another and you are invited to discuss your electrical power installation with our technical staff. Free advice and if necessary a report and estimate will enable you to judge whether the conditions of power consumption in your plant are needlessly wasteful. Anticipated annual savings sometimes running into many hundreds of pounds will show just how soon the capital outlay is recovered by the increase in electrical efficiency. Thereafter you will enjoy a net saving through reduced electricity costs.

REGISTERED TRADE MARK
HUNTS
CAPACITORS
THE TRADE MARK OF RELIABILITY

We manufacture wide ranges of capacitors for other industrial applications including Phase Splitting, Fluorescent Lighting, Motor Starting and Running, HF and RF Heating, Radio Transmission, Telephone Installations, Ignition and Interference Suppression.

A. H. HUNT (Capacitors) Ltd · Electrical Division · Vulcan Way, New Addington, Croydon, Surrey · Tel : Lodge Hill 2661-4
Head Office : Bendon Valley, Garratt Lane, Wandsworth, London, S.W.18
Factories also in Essex and North Wales

The NEW range of—

"MEMREX-EXEL" 500 volt Switchgear

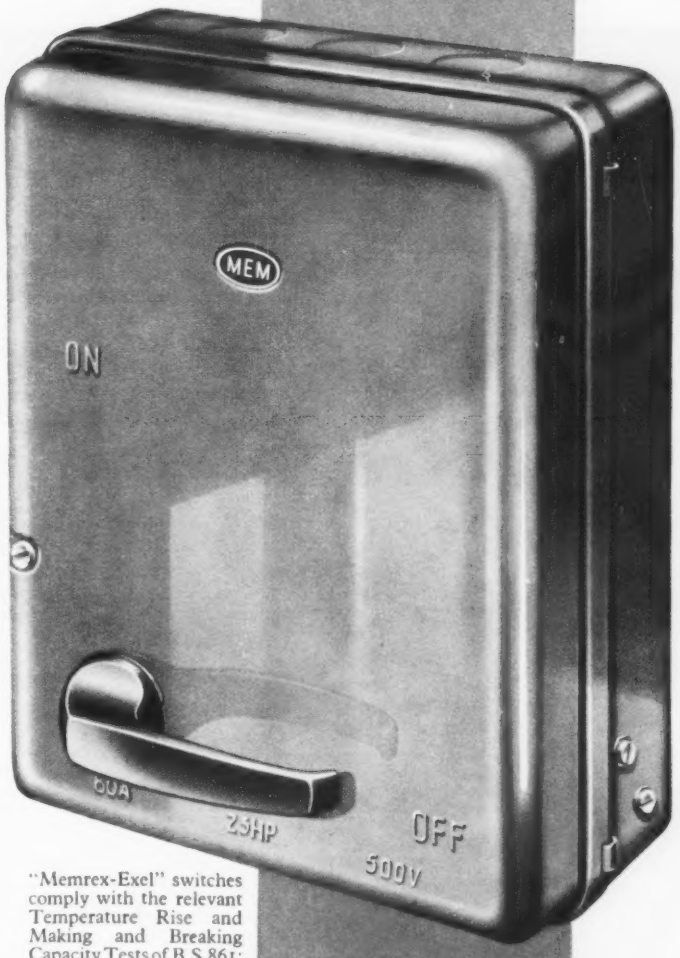
PRESSED STEEL ENCLOSURES
FOR LIGHTNESS AND STRENGTH.
FRONT OPERATING SWITCH HANDLES.
REWIRABLE OR H.R.C.

10—15—30 Amp. Switches
10—15—30—60 Amp. Switchfuses.

This new range of "Memrex-Exel" switchgear provides the most up-to-date and technically advanced range of 500 volt industrial switchgear yet offered to industry.
Modern styling, sound technical performance and compliance with all relevant British Standard Specifications are basic essentials. The range complies with the most strict interpretation of I.E.E. Regulations (13th edition), and with the requirements of The Electricity (Factories Act) Special Regulations.

Features include

Cases of one piece pressed steel with hinged covers, rustproofed and finished light grey stove enamel.
Front operating switch handles improve appearance and permit more compact assemblies on switchboard and panels.
Fuses are of the new "Kantark-Exel" pattern which will accept rewirable or H.R.C. fuses.
Semi-enclosed rewirable (damper type) patterns comply with B.S.3036 : 1958.
H.R.C. cartridge patterns which are interchangeable with semi-enclosed rewirable patterns, comply with B.S.88:1952, Appendix 'J' Dimensions.
M.E.M. H.R.C. cartridge fuse carriers are designed to accommodate H.R.C. cartridge fuse-links made to B.S.88 : 1952, Appendix 'J' Dimensions, Form A—Offset Tags.
M.E.M. H.R.C. cartridge fuse-links are available for use with this range of switchgear. All ratings have been A.S.T.A. certified for Categories of Duty 440 A.C.3 (16,500 amps), 440 A.C.4 (33,000 amps.) and 440 A.C.5 (46,000 amps.).



"Memrex-Exel" switches comply with the relevant Temperature Rise and Making and Breaking Capacity Tests of B.S.861: 1955 and B.S.2510: 1954.

All these and many other features.

MEM

WRITE FOR LIST 447 T

MIDLAND ELECTRIC MANUFACTURING CO. LTD.
REDDINGS LANE, TYSELEY, BIRMINGHAM, 11.

'Trilac' dipping and vacuum cleaning department of the 'CLEAN CONDITIONS' PLANT

S & L PIPEWORK FOR BRITAIN'S NUCLEAR POWER STATIONS

It is becoming general for many components for nuclear plants and other forms of construction to be assembled under entirely dust free conditions.

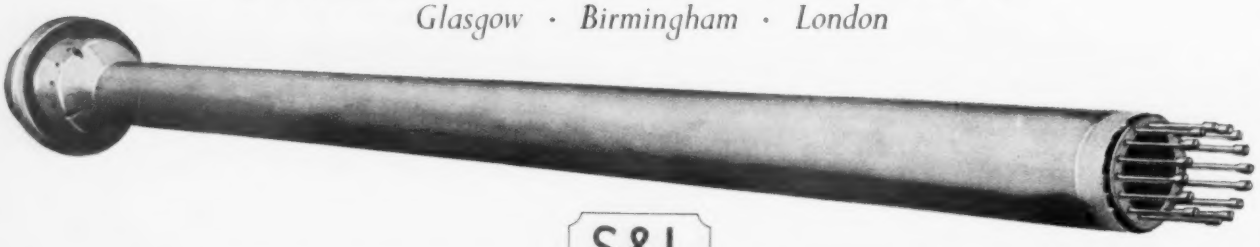
To meet the requirements of the nuclear age S & L have constructed a special 'clean conditions' plant at their Tollcross Works in Scotland. This new plant is probably the largest and best equipped in industry and comprises many important features, including fully filtered and heated air, a large assembly area, together with cleaning and protection facilities.

An example of the work assembled in this shop is the control rod standpipes for Hunterston nuclear power station. The standpipes shown in the illustrations accommodate boron rods and house the small bore burst slug detection piping.

S & L will be pleased to discuss any problems associated with clean conditioning of industrial components.

STEWARTS AND LLOYDS LIMITED

Glasgow · Birmingham · London



S&L

LEWBESTOS REGD.

heat resisting wires and strips

LEWBESTOS Insulated Wires and Strips are used in the winding of coils required to withstand relatively high working temperatures.

The covering on LEWBESTOS consists of selected long fibre asbestos, applied to the wire by a special process.

This 'felts' the fibres and includes the application of a heat resistant bonding medium.

PAPER INSULATED

round wires and strips

LEWCOS Paper Insulated Wires and Strips consist of a number of lappings of woodpulp or manilla paper applied closely and uniformly to the copper wire.

Various thicknesses of insulation can be produced over a wide range of wires and strips for application in transformers and other oil-immersed coils.

All these LEWCOS insulated wires and strips are available on good delivery.

THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED

LEYTON · LONDON · E10

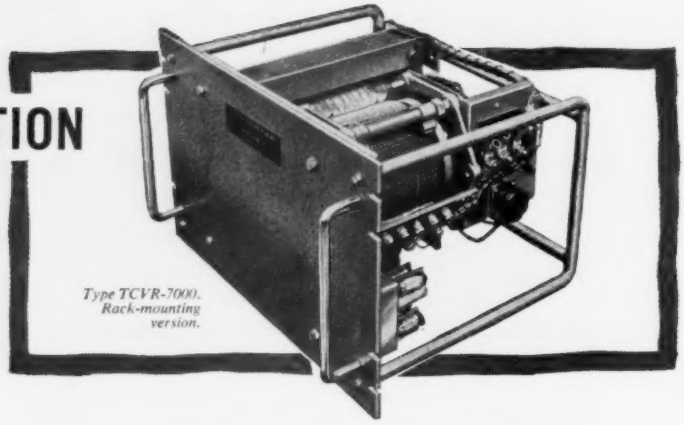
40 VOLTS/SEC AUTOMATIC CORRECTION

—with the type TCVR voltage regulator

The TCVR is a servomechanical automatic voltage regulator having the very high speed of correction of FORTY VOLTS PER SECOND. It provides an *undistorted* output, maintained constant within very close limits (normally ±0.5%) from no-load to full-load, for wide variations in frequency and power factor.

A wide range of models from 1.6 to 12 kVA single-phase, and 4.8 to 36 kVA three-phase, is available, to standard or tropical specification, in cabinets or for rack-mounting. Models are also available in which the output voltage is continuously adjustable over a wide range by means of a panel control. Regulators can be supplied to Services' specification, and special models can be designed to order.

For high-speed, accurate stabilisation *without distortion*—**specify TCVR.**



Type TCVR-7000. Rack-mounting version.

Other products of Claude Lyons Ltd. Stabiliser Division

BMVR: Motor-driven laboratory and industrial regulators ranging from 1·6 to 29 kVA single-phase, and 4·8 to 87 kVA three-phase. Constancy of output normally ± 0·5% from no-load to full-load. No distortion. Speed of correction 1 Volt/Sec. A great variety of models, standard, tropical and militarised, for all applications.

BAVR: Electronic stabilisers of very high accuracy, and very rapid response, with no moving parts. Input range : − 10% to + 5% output constancy ± 0.15%. Three sizes : 200, 500 & 1000 VA. Exceptionally useful for control of chemical processes, heating, lighting, etc.

ASR: Automatic step regulators, small, inexpensive, and with sinusoidal output waveform. Two sizes : 1·15 kVA and 2·3 kVA. Input range − 10% to + 5%; output constancy, ±2½%.

ATC: Automatic Tap-Changing Transformers — a development of ASR. Two sizes : 575 VA and 1150 VA. Input range − 20% to + 10% : output constancy, ± 5%. Provide adequate stabilisation for many types of apparatus, at low cost. Also useful as pre-regulators, e.g. in conjunction with BAVR.

We shall be pleased to send you full details of our entire range.

Claude Lyons Ltd.

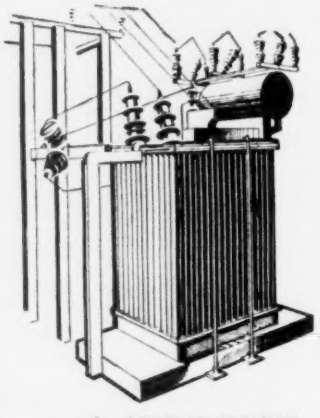
Stabiliser Division **VALLEY WORKS · HODDESDON · HERTS · TELEPHONE HODdesdon 4541-4**

CL/47/EX

NEO K TEX

The Electrical Industry's Most Reliable Jointing Material

SYNTHETIC RUBBER BONDED CORK



for PERFECT SEALING

GASKETS · WASHERS · SHEETS

SYNTHETIC and RUBBER MOULDINGS and EXTRUSIONS

KAUTEX LTD ELSTREE WAY · ELSTREE · HERTS

Telephone, ELSTREE 1777/8/9 and 1770

'Erskine Heap' installation at

THE CULTER MILLS PAPER CO. LTD.
PETER CULTER

The Switchgear and Motor Control Gear which is illustrated below is part of the installation of the new turbine house and modernisation of the electrical equipment at the mill.

The large centre illustration shows the new Power House with the A.C. and D.C. Switchgear for controlling the 2400 KW Alternator and the 850 KW D.C. generator of the new turbine set.

In the lower illustrations are other switchboards and motor control gear typical of those throughout the mill.

Consulting Engineer, A. B. Mallinson, M.I.Mech.E., M.I.E.E.

ERSKINE, HEAP & Co LTD

SWITCHGEAR SPECIALISTS

Head Office & Works BROUGHTON, MANCHESTER (7)

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BRANCH OFFICES AND AGENCIES IN ALL PARTS OF THE WORLD

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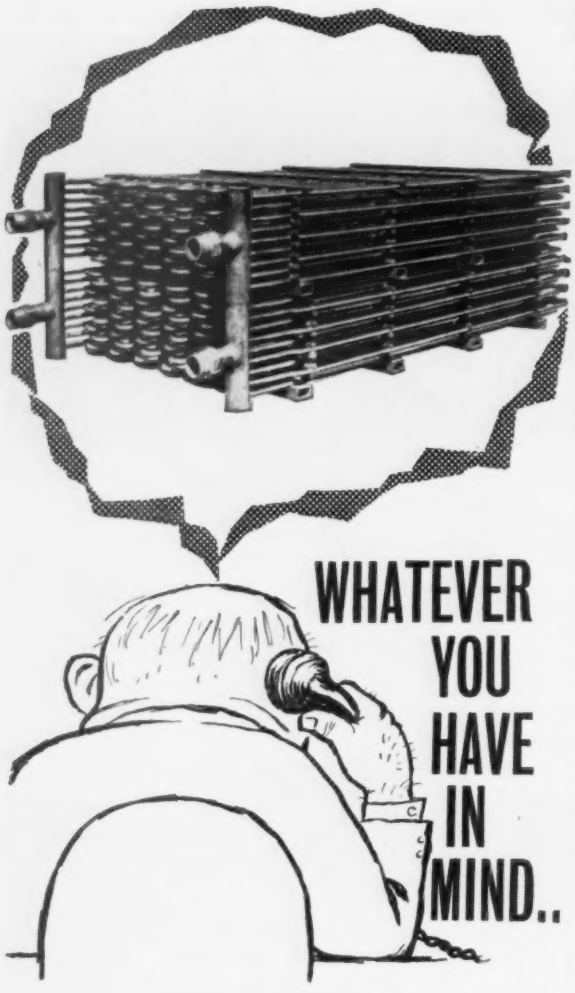

Metal Spinnings, Tube Manipulation, Coil Production, Coppersmithing, these are the industrial fields in which we have worked since 1780. Our traditional skills are supported by modern plans and the latest techniques. Spinnings can be produced in any metal or alloy from blanks up to 7 ft. in diameter and tolerances of ±·005 inch. Quantity is no problem and tool facilities are available.

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Smiths in any metal

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A.I.D. and A.R.B. approved

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H.31

INTERLOCKS

assure correct sequence control and increase safety

★ VIRTUALLY UNLIMITED DIFFERS

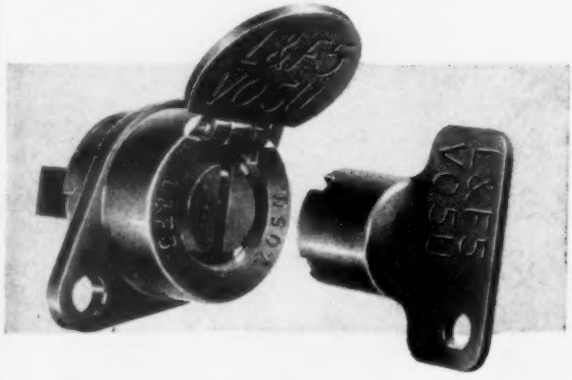
★ NO MASTER KEYS

★ POSITIVE LOCKING

A safety lock, approved by the Central Electricity Generating Board, and backed by 70 years of lock manufacturing experience.

Our service includes the assistance of technical staff whenever and wherever required.

The "Engineers Manual of Interlocks and Allied Locking Devices" gives details of design, dimensional drawings and ordering arrangements. Please write for a copy.



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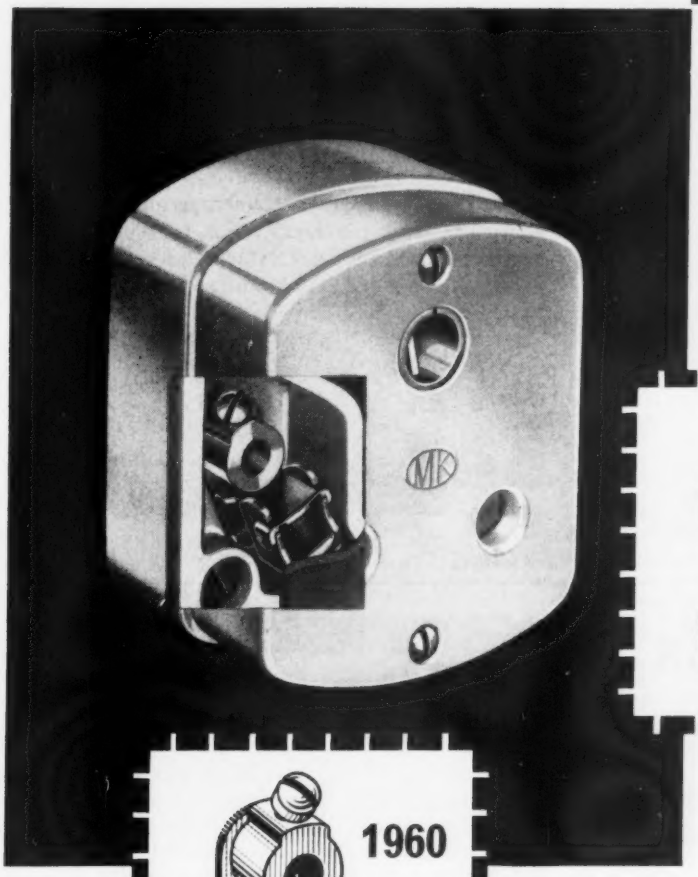
Combination Works, **WILLENHALL, STAFFS.**

Telephone: WILLENHALL 1111 (5 lines P.A.B.X.)
Grams: Squirrels WILLENHALL

MK178DHB

The origin of MK



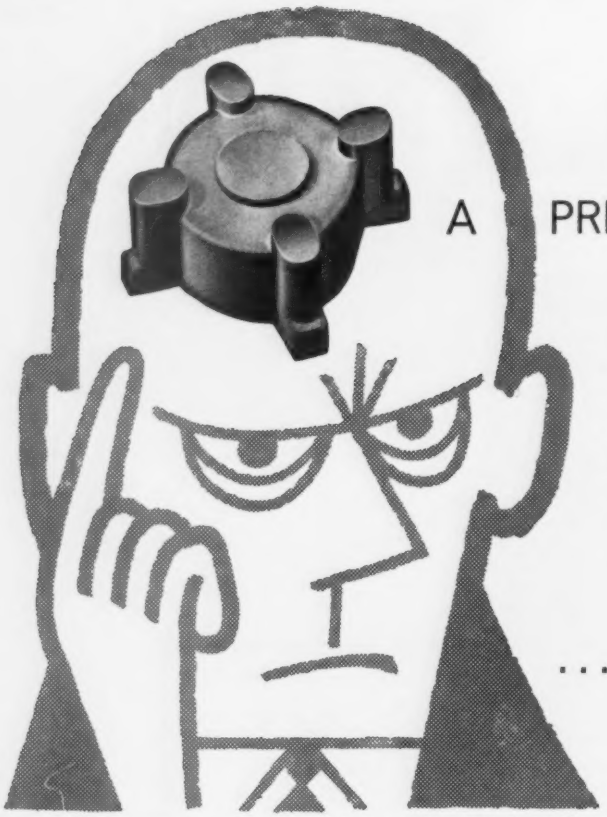
In 1919, Patent No. 136439 was granted for our first spring grip socket. Machined from hard drawn brass tubing, the walls of the socket were sawn*, creating spring contact tongues. Thus, many points of contact were provided. And the name chosen for this new socket? . . . 'Multy-Kontact' . . . the origin of MK.

**Sawn to form an undivided circle of metal at the entry. This 'limit ring' prevented the insertion of plug pins oversize in diameter or out of alignment —thus the contact tongues were protected from distortion and permanently retained their spring pressure.*

In 1960 all MK sockets although made to later patents still retain the two vital features of the original patent—spring contact tongues, protected from distortion by a restrictive entry.

Trade Mark registered in Great Britain and many other countries.

MK ELECTRIC LIMITED, SHRUBBERY ROAD, LONDON, N.9. EDMONTON 5151



Have you A PRESSING PROBLEM?..

Accuracy, good finish, consistent high quality—these come naturally with Sutcliffe Speakman hot pressings and stampings. Machining can be undertaken to limits down to .0005″.
No quantity is too large, no job too complicated, no standard too exacting.

Pressings and stampings in non-ferrous alloys including aluminium, brass, chromium-copper, cadmium-copper, manganese bronze and nickel silver. Castings in gun-metal, phosphor bronze and heat-resisting nickel chrome alloys.

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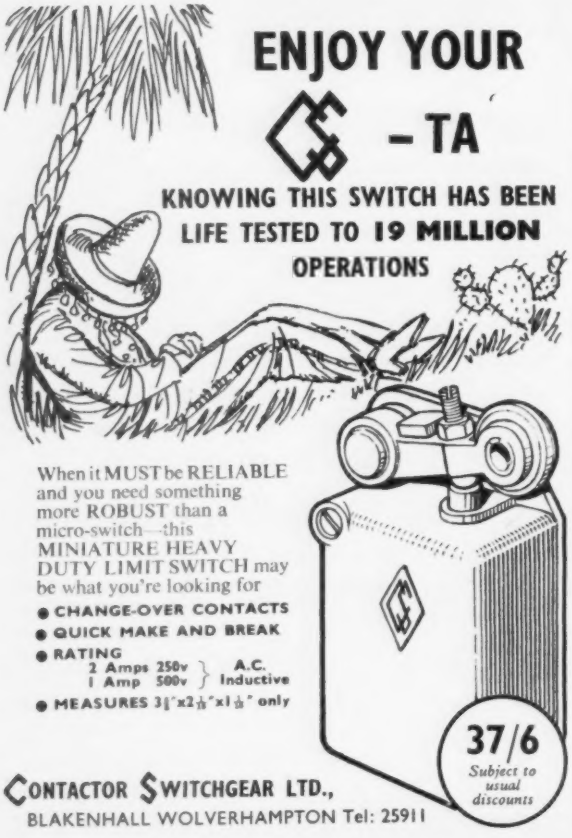
SUTCLIFFE SPEAKMAN & CO. LTD., Leigh, Lancashire. Tel: Leigh 94. *London Office: 2 Caxton St., Westminster, S.W.1. Tel: Abbey 3085*



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KNOWING THIS SWITCH HAS BEEN LIFE TESTED TO 19 MILLION OPERATIONS

When it MUST be RELIABLE and you need something more ROBUST than a micro-switch—this MINIATURE HEAVY DUTY LIMIT SWITCH may be what you're looking for

- **CHANGE-OVER CONTACTS**
- **QUICK MAKE AND BREAK**
- **RATING** 2 Amps 250v } A.C. 1 Amp 500v } Inductive
- **MEASURES 3½″x2⅛″x1⅛″ only**

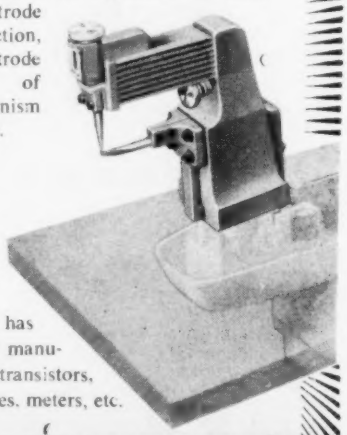
37/6 *Subject to usual discounts*

CONTACTOR SWITCHGEAR LTD.,
BLAKENHALL WOLVERHAMPTON Tel: 25911

SPOT WELDING

UNIT TYPE 'BH'

DISTINCTIVE FEATURES: Capable of highest welding speeds e.g. 1 millisecond weld pulse. Moving electrode system free from play or backlash. Electrode movement at instant of weld truly linear. No mechanical variants in moving electrode system due to friction, etc. Moving electrode is independent of operating mechanism at instant of weld.



HED

The 'BH' welder has many uses in the manufacture of valves, transistors, resistances, watches, meters, etc.

HIRST ELECTRONIC LTD.
GATWICK ROAD, CRAWLEY, SUSSEX

this is happening everywhere!

Special offer!

Initial orders for 12 and more will be supplied in this attractive display carton

Yes, everywhere people are buying a "Reguplug"! Housewives, householders, handymen—they are all pleased with this good idea which Sunvic call the "Reguplug". When customers see the "Reguplug" displayed—*they buy!* For here at last is a handy little device for controlling heat output of numerous electrical appliances. The "Reguplug" enables people, quite simply, to regulate an appliance to give just the heat required. Saves switching on and off—*saves electricity!* Ideal for heated carpet underlay, airing and drying cabinets, percolators, kettles, electric blankets, soldering irons, glue pots, heating platens, urns, wash boilers, sterilising equipment, and any electrical heating appliance.

Retail Prices

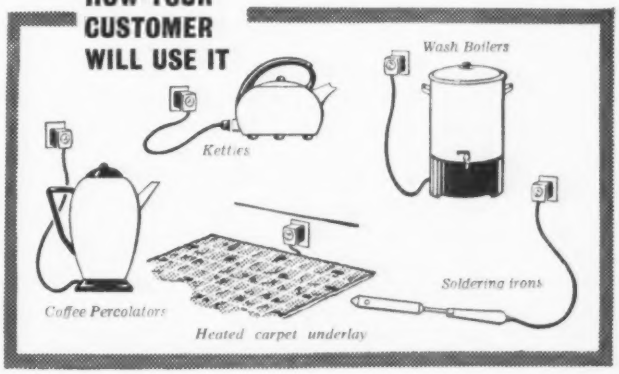
REGUPLUG
15 amp round pin . . . **35/**

REGUPLUG
13 amp
flat pin (fused) **37/6**

WHAT IS THE "REGUPLUG"?

The "Reguplug" is the "Simmerstat" designed to fit directly into a three-pin socket. It provides any piece of electrical heating apparatus with continuously variable control from off to full. Definite dwells are provided in the OFF and HIGH positions. Moulding is of high quality bakelite, white or brown. Silver contacts. For 13 amp and 15 amp circuits, 230/240V A.C., complying with BSS 1363 and BSS 546 respectively.

HOW YOUR CUSTOMER WILL USE IT

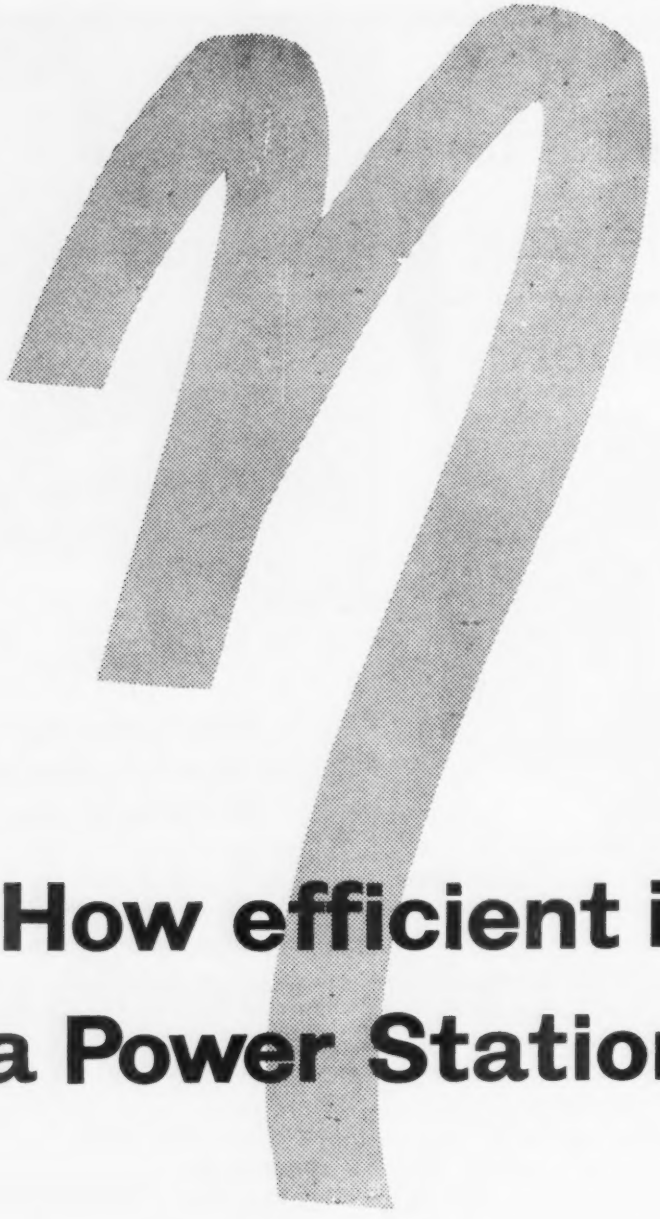


The Sunvic "Reguplug" is a product of:

AEI

Instrumentation Division
P.O. Box 1 Harlow Essex Harlow 25271
Associated Electrical Industries Limited

sc/93a



How efficient is a Power Station?

The term 'efficient' is often used loosely as an alternative to 'effective'. In Electricity Supply, however, the 'efficiency' of a power station has a well-defined and exact connotation. It indicates the heat energy expended to produce a unit of electricity.

Progressively, new power stations are more 'efficient' than their predecessors — they burn less coal for a given output. The engineers of the Central Electricity Generating Board are producing designs which, by increasing efficiency, enable power stations to offset substantially the rising costs of materials.

In spite of increased efficiency, however, the available supply of suitable coal cannot long keep pace with the demand for electricity, which doubles every decade. The gap that threatens in the not distant future will now be filled by the rapidly expanding nuclear power programme.

CEGB

THE CENTRAL ELECTRICITY GENERATING BOARD

NEWS SHEET

AEI, Reyrolle, Parsons to pool research. Joint programme agreed; with full information exchange. AEI. acquire 20% holding in Parsons from Reyrolle. (663)

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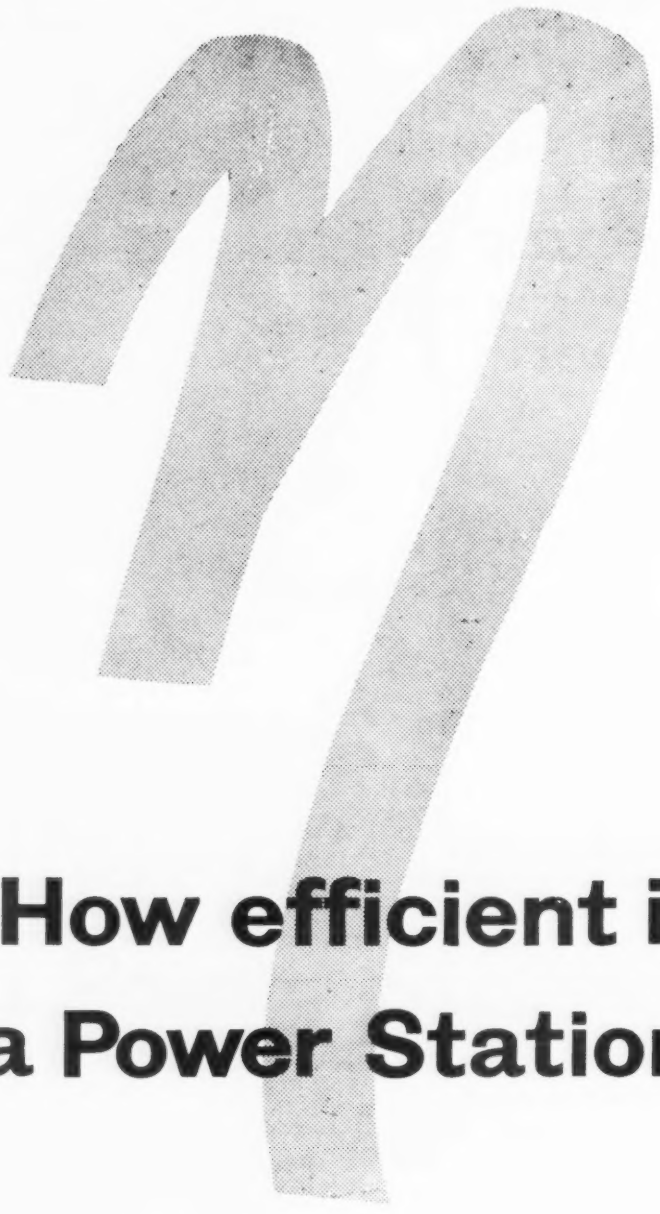

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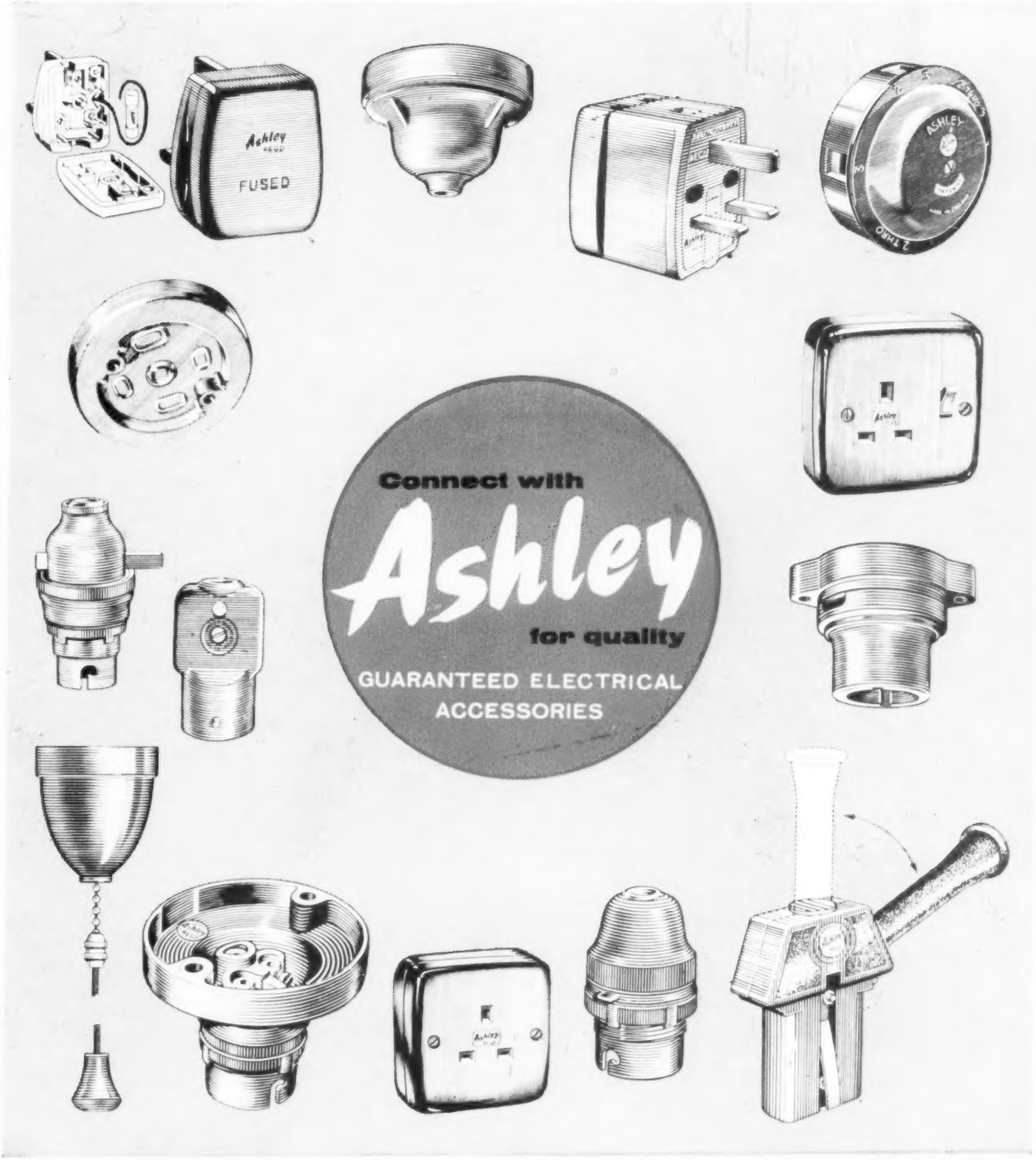

DISCRIMINATING USERS SPECIFY "ASHLEY"

The wiring accessories illustrated are typical examples of the "Ashley" range

Constant technical developments and production control ensure efficient, reliable products of high quality and finish, which comply with or surpass the relevant British Standards and offer many special features.

The 13 amp range includes High Impact Fused Plugs and Heavy Duty Sockets with mouldings of special material for heavy duty, finish black. Ideal for use in factories, garages, schools, etc.

Illustrated Catalogue available on request

ASHLEY ACCESSORIES LTD., ULVERSTON, LANCASHIRE, ENGLAND

Tel: ULVERSTON 3333 Grams: "ASHLEY" ULVERSTON

C

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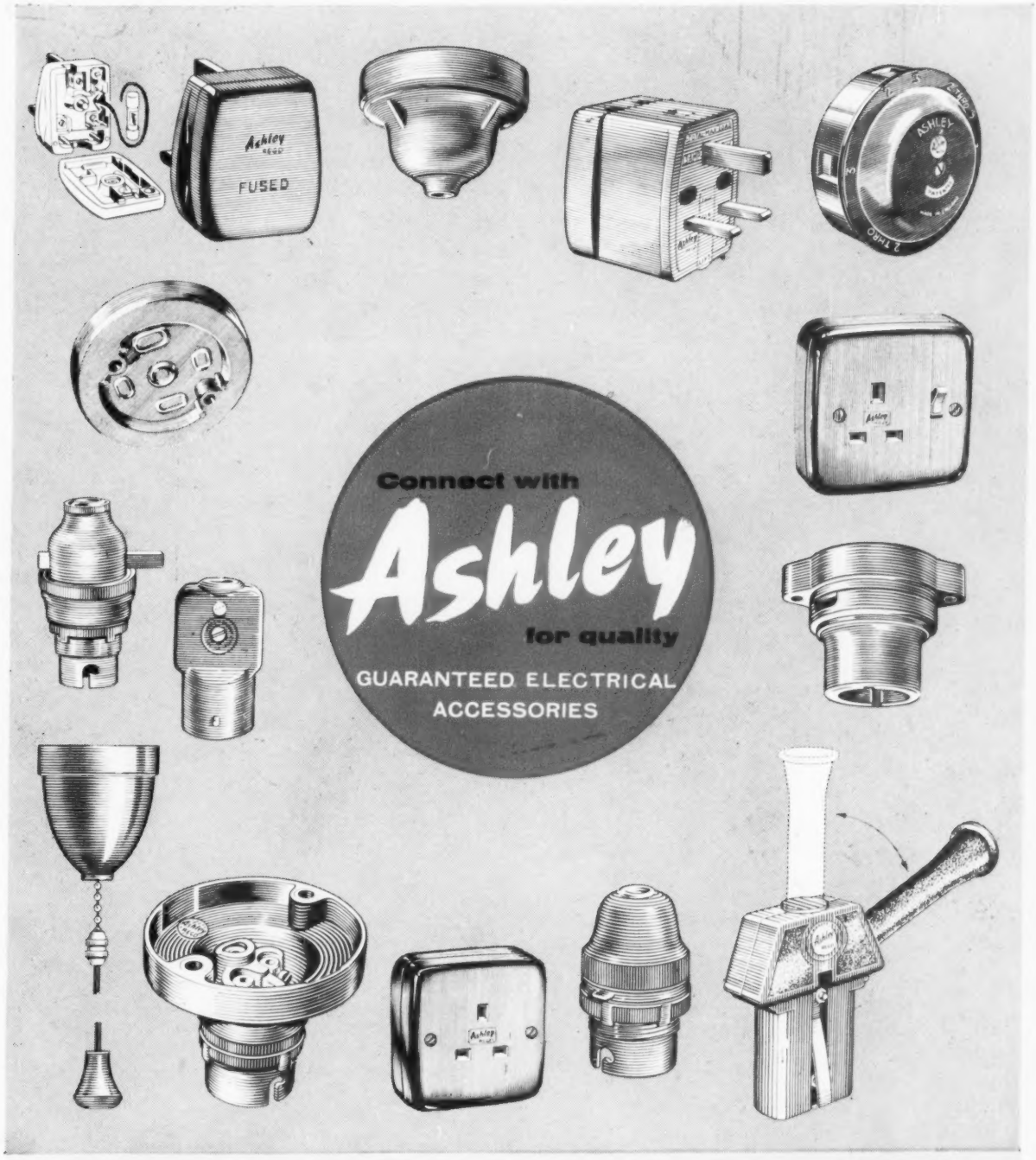

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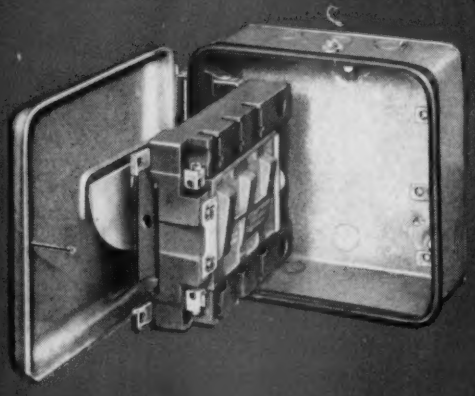

Star Switchfuse with cover open showing interior hinged forward for ease of wiring

Simplex Star

A BRILLIANT NEW RANGE OF DEAD-FRONT SWITCHGEAR WITH EVERYTHING PLUS BUT THE PRICE

The Simplex Star range — a low priced, high quality range of switchfuses, distribution boards busbar chambers, and switchboard assemblies.

SWITCHFUSES

- ★ Range: AC 500 volt, 15, 30, 60 amp. DC 250 volt, 10, 20, 30 amp.
- ★ Dead-front — all live parts fully shrouded even with fuses removed.
- ★ Front operated.
- ★ Flag indication.
- ★ HRC or rewireable fuses.
- ★ Rewireable fuses (patents pending) complying fully with B.S.3036 1958.
- ★ Unique ease of wiring facilities.

DISTRIBUTION FUSEBOARDS

- ★ Two ranges, both: AC 500 volt, 15, 30, 50 amp; DC 250 volt, 15, 30, 60 amp.
- ★ Dead-front — all live parts fully shrouded even with fuses removed.
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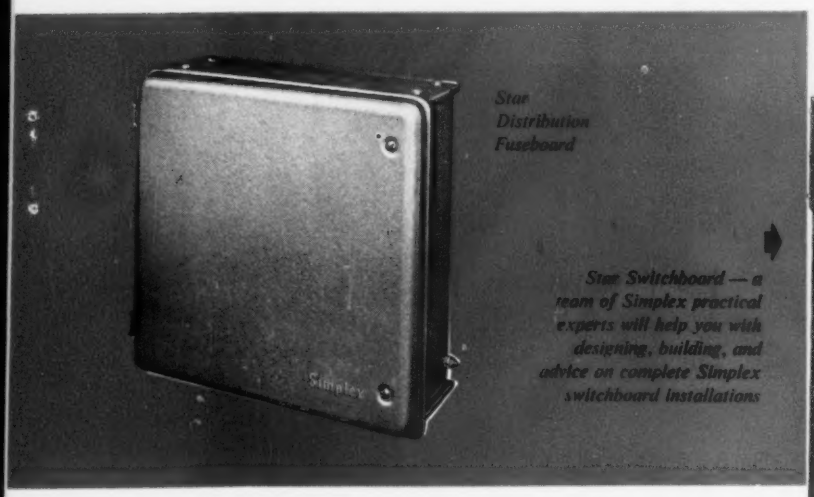
- ★ Rewireable fuses (patents pending) complying fully with B.S.3036 1958.
- ★ Unique ease of wiring facilities.
- ★ Surface or flush-mounted.
- ★ Reversible interior and cover hinging.

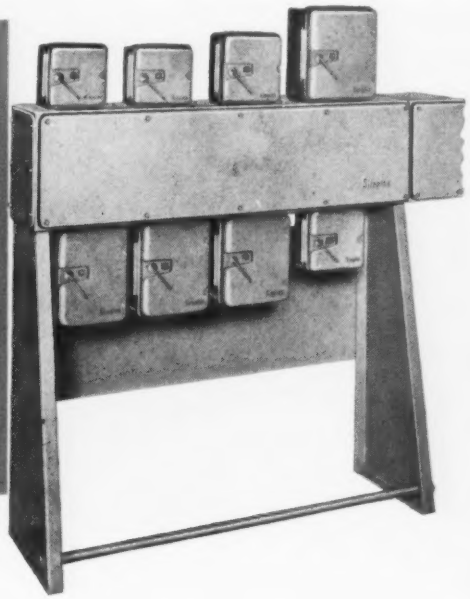
BUSBAR CHAMBERS AND SWITCHBOARDS

- ★ Range: 600 volt, 200, 400, 600, 800 amp. 24″, 36″, 48″.
- ★ High through-fault capacity.
- ★ Readily extendible.
- ★ Universal clamp connections — no drilling — no sweating.
- ★ Fully gasketed.
- ★ Switchboard stand assemblies.
- ★ Switchboards available with Simplex S & S automatic control gear, fused switches, isolators, etc.



Star Distribution Fuseboard

Star Switchboard — a team of Simplex practical experts will help you with designing, building, and advice on complete Simplex switchboard installations



Send for the Simplex Star switchgear catalogue if you haven't already received one.

Simplex

SIMPLEX ELECTRIC COMPANY LIMITED · BLYTHE BRIDGE · Nr. STOKE-ON-TRENT · STAFFS.

Branches throughout Gt. Britain and agents throughout the world

TI COMPANY

Controlled Circulation Reheat Boiler Units

The large capacity International Combustion steam raising units, for which contracts have recently been placed by the Central Electricity Generating Board, have been designed for assisted and controlled circulation.

FUEL EFFICIENCY EXHIBITION

Stand No. 6C

Ground Floor, Grand Hall, OLYMPIA

27th April - 6th May

200 MW

At HIGH MARNHAM Power Station the first of the five 200 MW units has been commissioned.

Evaporation . . . 1,400,000 lbs. per hr.
Steam Pressure . . . 2,450 p.s.i.g.
Superheat Steam Temperature . . . 1,060°F
Reheat Steam Temperature . . . 1,005°F

550 MW

This capacity from a single boiler unit will be greater than that of any other known design in the world. The 550 MW twin furnace unit to be installed at THORPE MARSH Power Station will have the following operating conditions:

Evaporation . . . 3,750,000 lbs. per hr.
Steam Pressure . . . 2,400 p.s.i.g.
Steam Temperature . . . 1,055°F
Reheat Steam Temperature . . . 1,055°F

INTERNATIONAL COMBUSTION LIMITED

NINETEEN WOBURN PLACE LONDON WC1 · WORKS: DERBY

Member of Atomic Power Constructions Limited, one of the British Nuclear Energy Groups

TGA G119/1

'Tis distance lends enchantment to the view,
And robes the mountain in its azure hue.

(Pleasures of Hope by Thomas Campbell)

By courtesy of Tourist Information Centre, Belfast

Irish cables are manufactured amidst scenery depicted above, showing the famous and beautiful Mourne Mountains.

IRISH CABLES will stand inspection right through to the very core, as a result of the high quality of materials used and constant vigilance and inspection throughout manufacture

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Phase-Earth
Loop Impedance Tester

An actual phase to-earth fault is applied momentarily and the Tester checks that the prospective fault current of three times the fuse rating can flow.

Model No. 1 for testing single-phase or three-phase four-wire earthed neutral supplies up to 60 amperes. Selected fuse ratings 15, 30, 40 and 60 amperes. Suitable for P.M.E systems (Protective Multiple Earthing).

Model No. 2 has additional facilities for testing up to 150 amperes, single-phase and three-phase, three or four-wire. Selected fuse ratings 15, 30, 40, 60, 75, 100 and 150 amperes. Suitable P.M.E systems (Protective Multiple Earthing).

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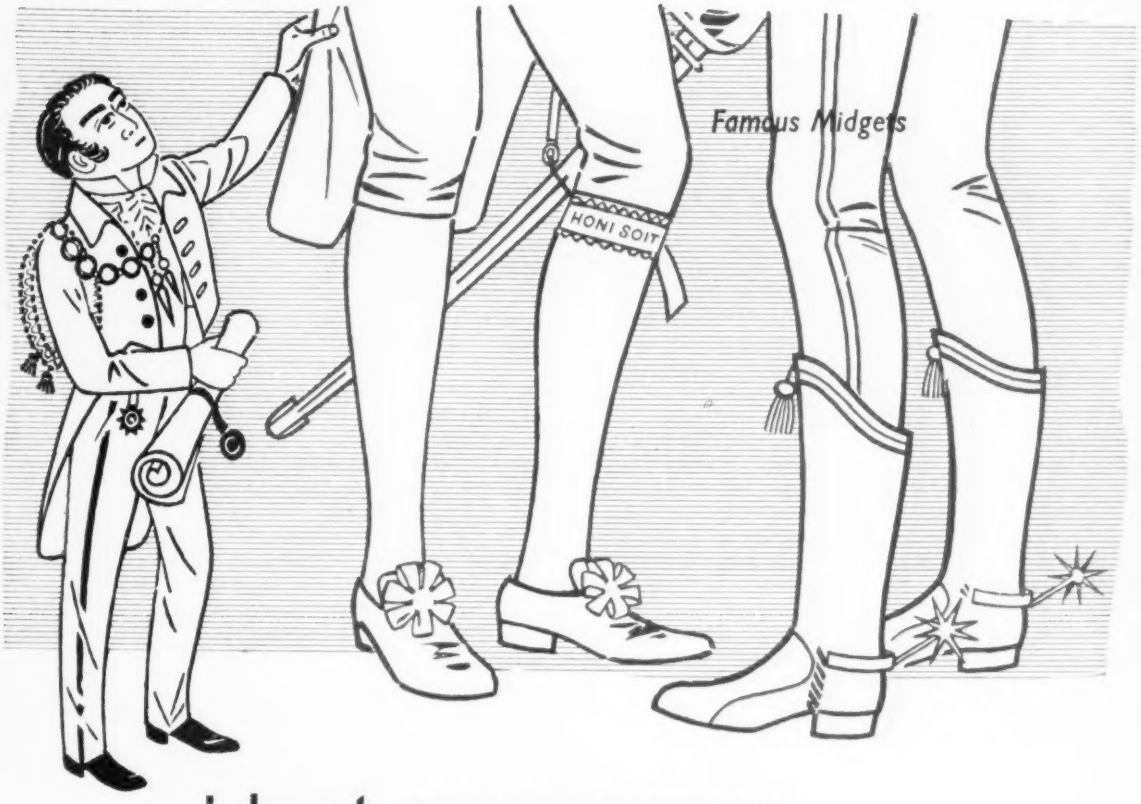


midget messenger

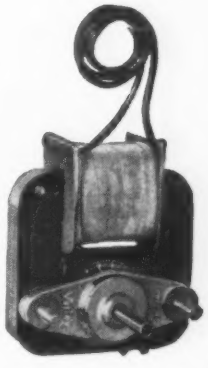
The Houses of Parliament had their own dwarf during the 30s and 40s of last century. This was George Trout, 2′ 6″ high, a messenger to both Peers and Commons. The Gentlemen Usher of the Black Rod is recorded as giving him several suits of clothes so that he might appear more respectable in the lobby of the Lords, but Trout, finding that charity was encouraged more by a shabby appearance, pawned this finery and was dismissed.

Varley
REGD. TRADE MARK

small electric motors

S.C.9. ¼″, ¾″, 1″ This new Varley range features a one-piece moulded bobbin, and a silver steel shaft. Mounting brackets are die-cast with 2BA studs in line with bearing bracket for ease of location. Bearings are sintered, with additional felt oil reservoirs for long life and a ball end-thrust bearing is fitted as standard.

Applications Air circulation, agitators, vending machines, displays, domestic appliances, and fans.



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10 TIMES BETTER OFF WITH CLASS H MOTORS

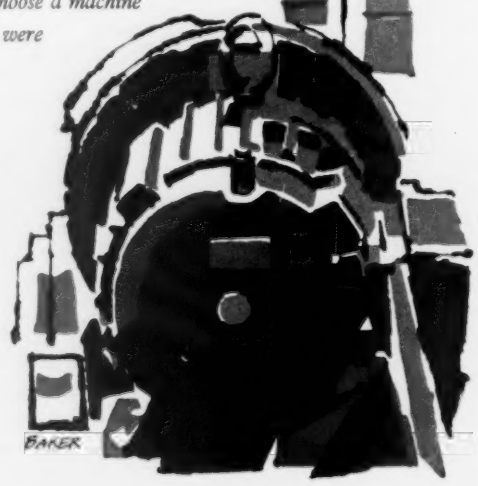
If the insulation system of one electric motor lasts ten times as long as that of another—it's something you should know about! So here are the plain facts about Class H Motors.

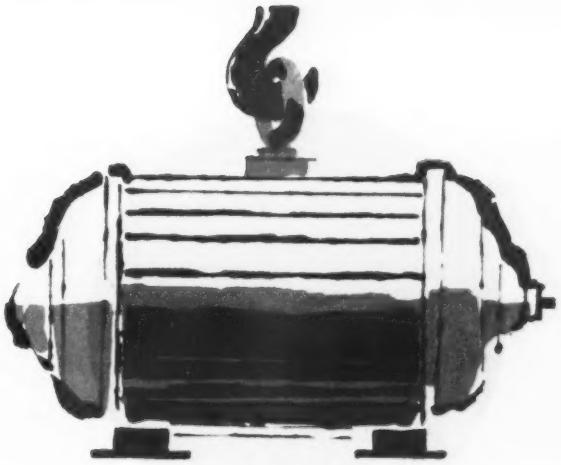
***Continuous** running tests have proved conclusively that the insulation life of Class H machines outlasts that of Class A or B motors by* more than ten times. *Although silicone-insulated motors cost more initially, the extra outlay is repaid time and time again in terms of lower replacement costs, lower maintenance costs and lower production losses due to breakdown.*

***No** matter how testing the working conditions, Class H Motors will take the strain. High humidity levels . . . high working temperatures . . . heavy overloads. All these 'occupational hazards' the Class H Motor can take in its stride since MS silicone insulation reduces the risk of breakdown to the very minimum. And because these motors are so resistant to overload, it's often possible to choose a machine of lower capacity than if a Class A or B machine were being used. Result—still further economies.*

***So** don't imagine that the Class H Motor is in the 'luxury' class . . . something to be specified only in exceptional conditions. On the contrary, a silicone-insulated motor is today's first choice—no matter what the circumstances!*

MS





REMEMBER SILICONES FOR REWINDS TOO

The value of silicone insulation is by no means restricted to new machines. Many a troublesome Class A or B motor—given to repeated breakdowns—has been totally transformed by a timely silicone rewind.

At the Latchford Locks Works of the British Aluminium Co. Ltd. a centrifuge, used for cleaning aluminium swarf, is powered by a 15 HP motor which is mounted beneath the centrifuge. To help in the cleaning, live steam at about 10 psi is admitted to the centrifuge while it is in motion. The motor, when new in 1954, was wound with Class A insulation, but failed after eight months due to condensation on the windings. Rewound with Class A it failed again—this time after only two weeks' service. To prevent repetition of these failures the motor was then rewound using silicone insulation, and in fact ever since it was recommissioned in May 1955, British Aluminium report, 'the centrifuge has been used almost constantly without further trouble with the motor windings'. They go on to say, 'There is no doubt that the employment of silicone insulation has greatly lengthened the trouble-free working of the winding of this motor.'

Amongst *the leading manufacturers of Class H motors are: Associated Electrical Industries (Rugby) Ltd · The English Electric Co Ltd · The General Electric Co Ltd · Bruce Peebles & Co Ltd · Woods of Colchester Ltd · Brook Motors Ltd · Lancashire Dynamo & Crypto Co Ltd · Brush Electrical Engineering Co Ltd · Howells Electric Motors Ltd · Laurence, Scott and Electromotors Ltd.*

For a list of names of the many rewinders experienced in the use of silicone insulation, contact your nearest Midland Silicones branch office.

All over Britain, MS silicones are strengthening the weak link in electrical equipment—its insulation. Midland Silicones Ltd manufacture a full range of silicone products for use in the electrical industry. And Midland Silicones Ltd consistently set the pace for progress in this fast-developing field.

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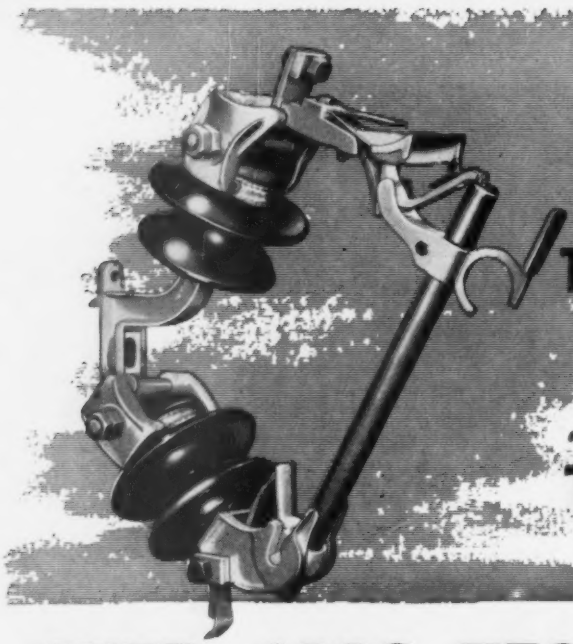

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150 MVA at 11 kV

OVER 1000 TESTS prove the reliability of J. & P. 'D' Fuse-Switches for overhead line protection.

During an extensive research and testing programme involving over 1000 short-circuit tests, J. & P. have again proved the efficiency of the Type 'D' Fuse-Switch and with only minor modifications to the original design have succeeded in up-rating it to 150 MVA at 11 kV. It has been fully certified for this breaking capacity at the C.E.S.I. Laboratories, Milan.

250,000 UNITS and 25 years' experience lie behind the J. & P. 'D' Fuse-Switch. Few items of electrical equipment have been so thoroughly proved in the field as the 'D' Fuse-Switch which has undergone only minor changes in design since it was first introduced in 1934.

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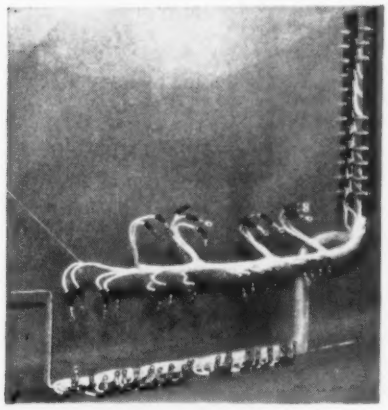
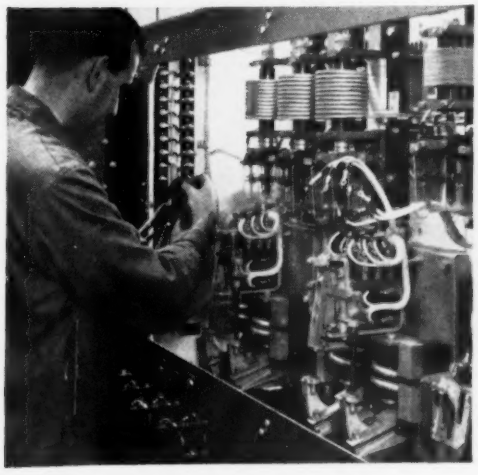
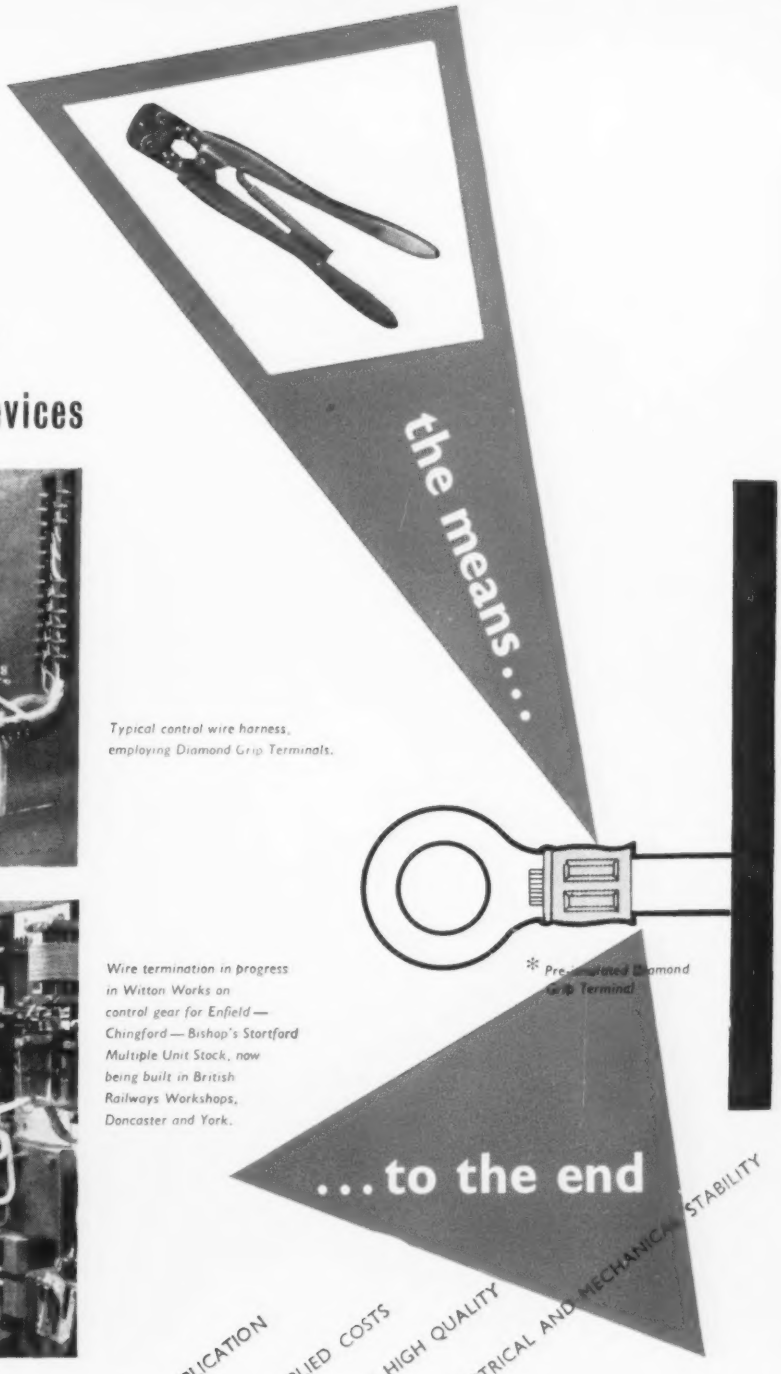


Typical control wire harness, employing Diamond Grip Terminals.



Wire termination in progress in Witton Works on control gear for Enfield — Chingford — Bishop's Stortford Multiple Unit Stock, now being built in British Railways Workshops, Doncaster and York.

With acknowledgments to the General Electric Company Limited



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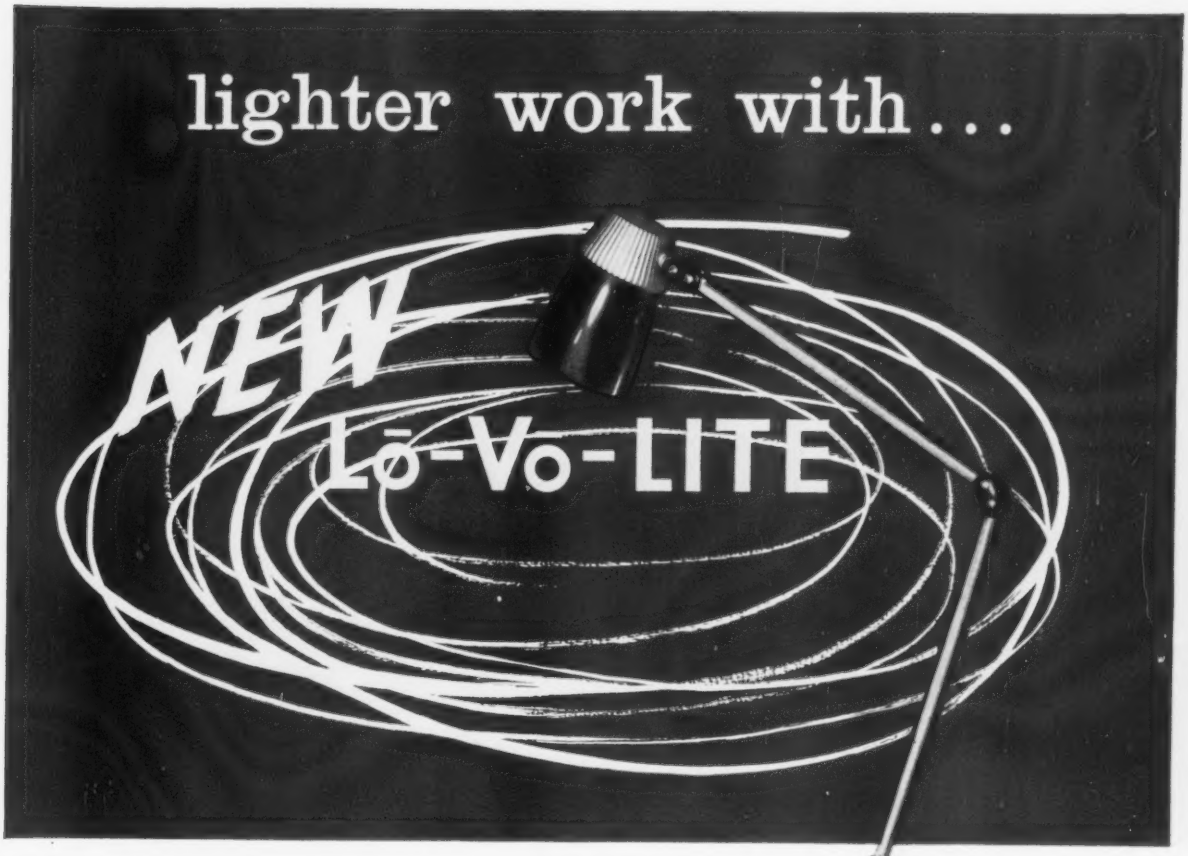

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Lo-vo-lite is especially recommended for laundries, bottling plants, and other 'wet' industries.

The Lō-Vō-LITE transformer can be mounted, not only on the machine exterior but also upside-down, built-in to a machine, on a wall, on a bench; or can be portable.

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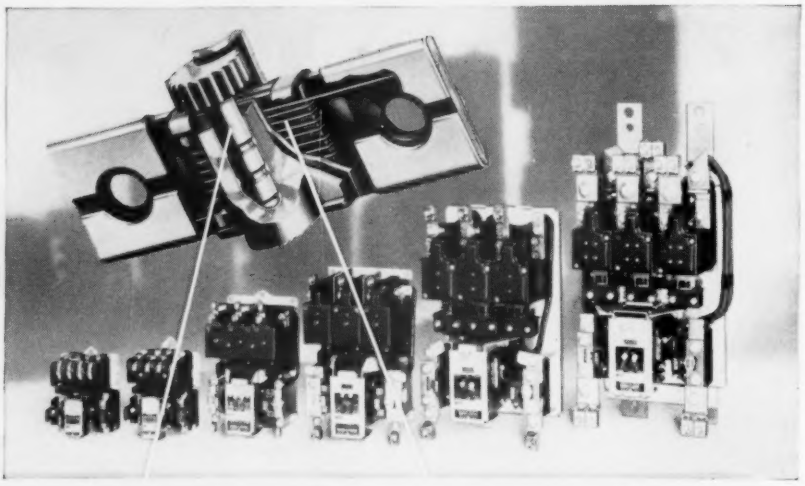

Heat-responsive element *(solder pot) provides accurate response to overload, yet prevents nuisance tripping.*

Heat producing element *is an integral part of overload unit. It's permanently joined to solder pot, can't become misaligned.*

Only ONE-PIECE Overload Relays can give 100% Protection.

Only with ONE-PIECE construction can you *know* you've installed the heater correctly. Only with ONE-PIECE construction can you *know* the heater is exactly centred, or properly positioned, so that it performs according to its rating. Only with ONE-PIECE construction can you *know* your starters will not operate without the thermal units properly installed. Only with ONE-PIECE construction can you *know* your motors have full protection.

Only Square D has ONE-PIECE Construction. ONE-PIECE construction eliminates any possibility of heater misalignment. Square D melting alloy thermal overload relays can be installed only one way. They are tamper-proof. They are factory-assembled, are individually calibrated and tested. Repeated tripping will not affect their accuracy.

Insist on square D starters with melting alloy thermal overload relays

LET US PROVE IT!

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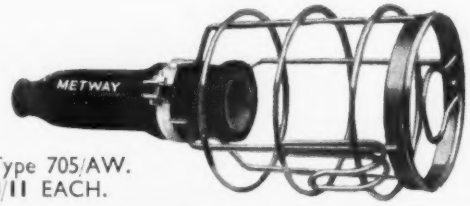

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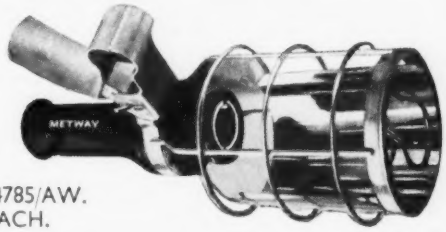
Type 2705/AWS with switch. 11/11 each.



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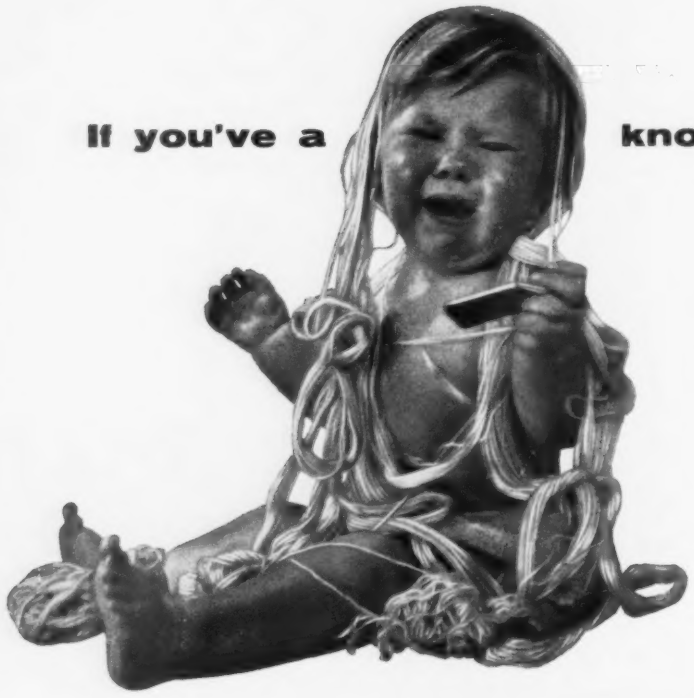

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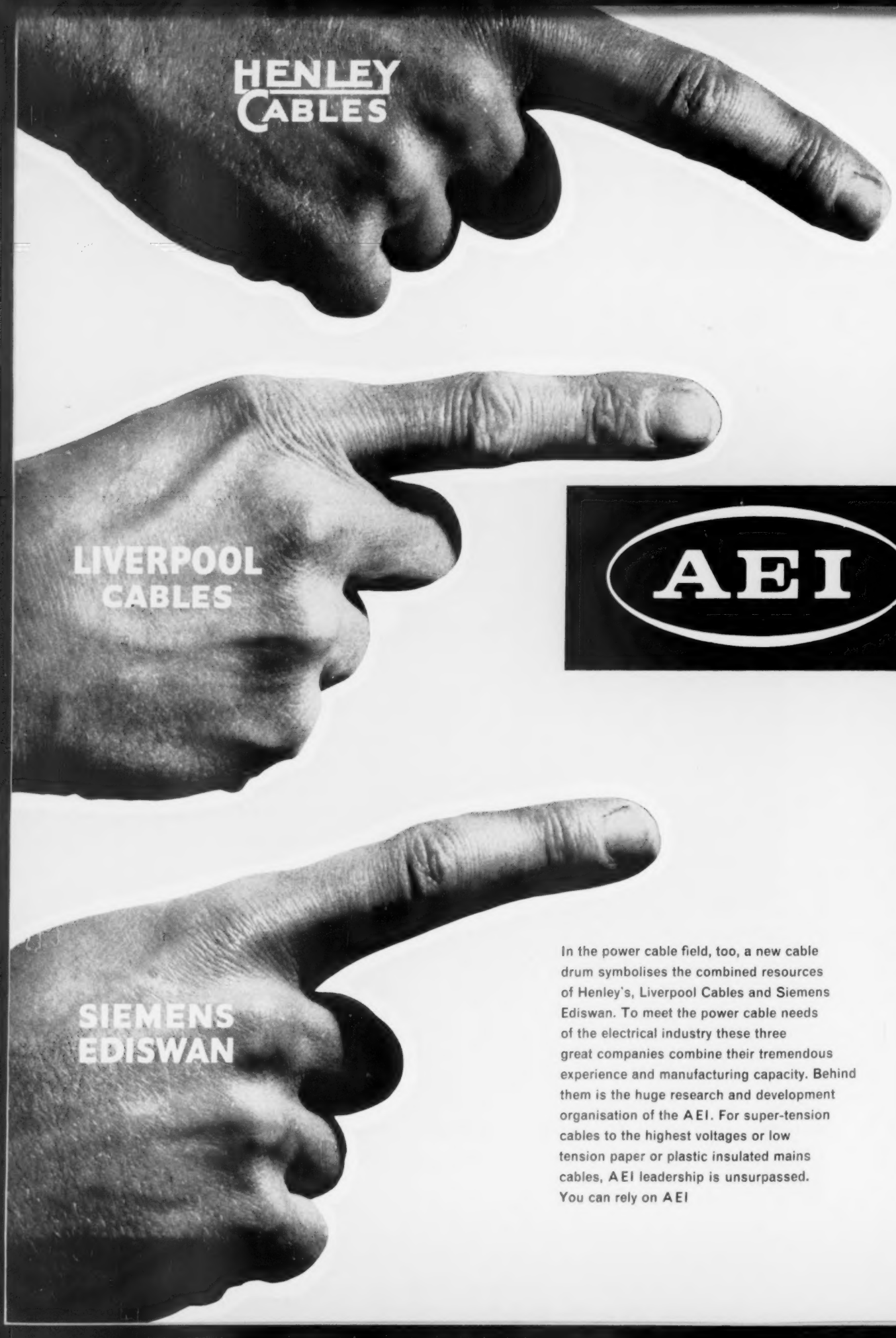

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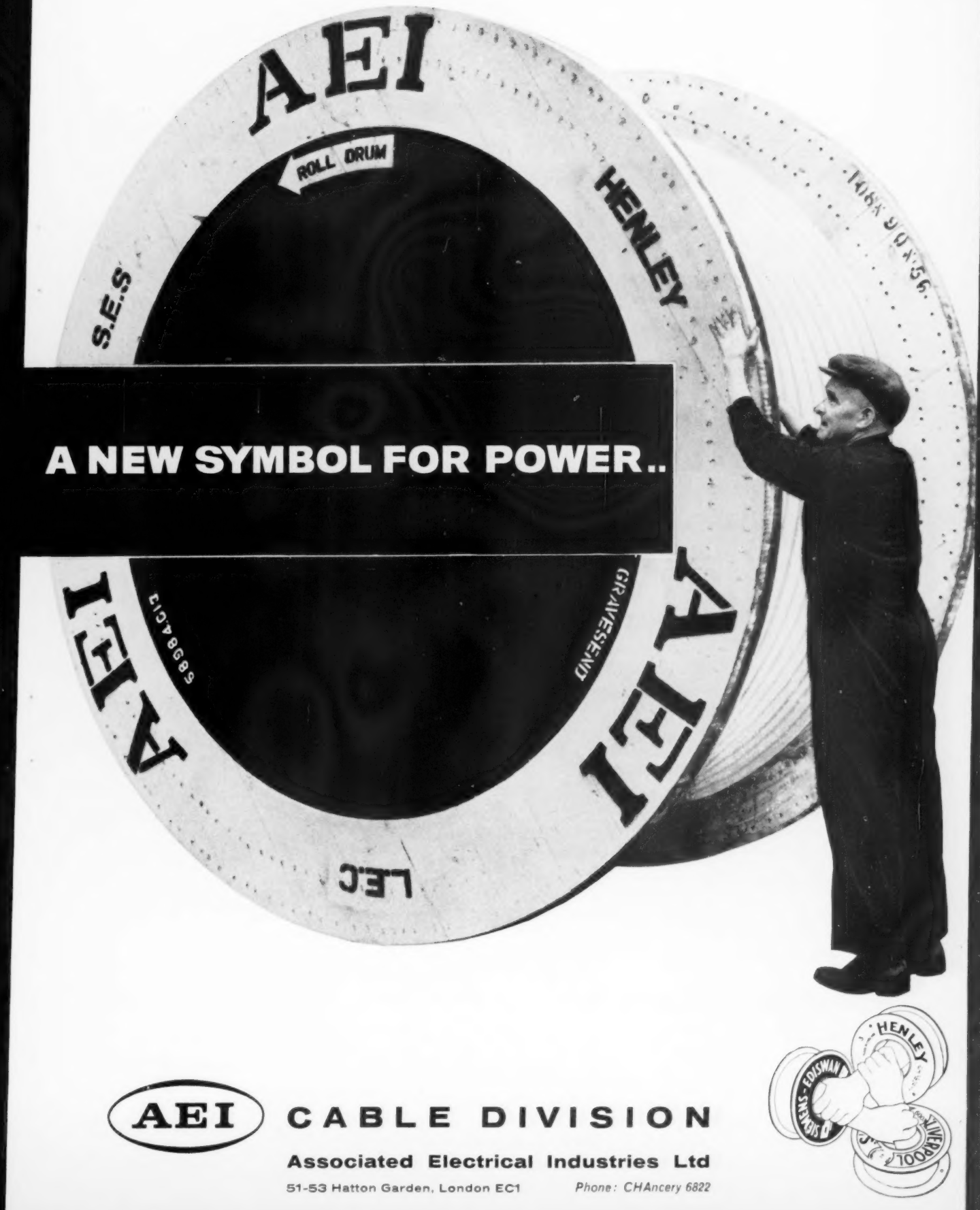
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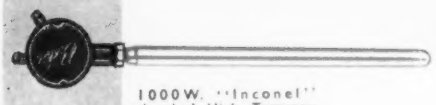

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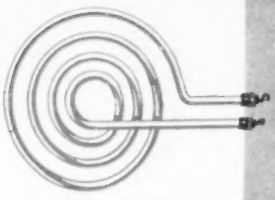

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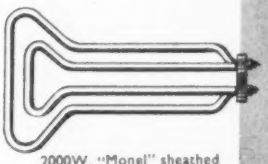

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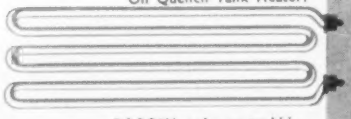

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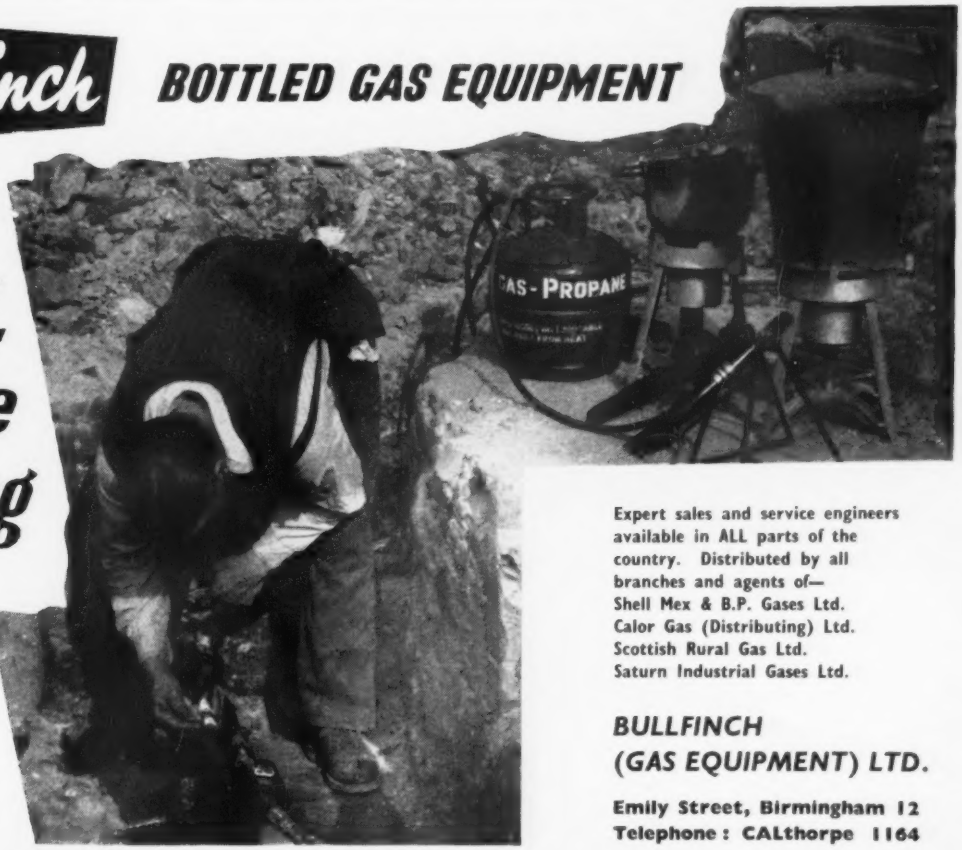

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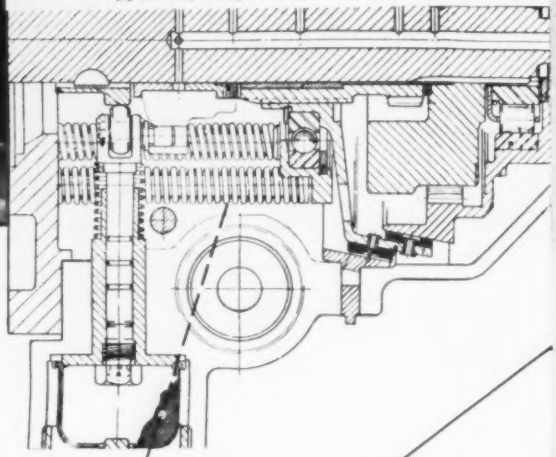

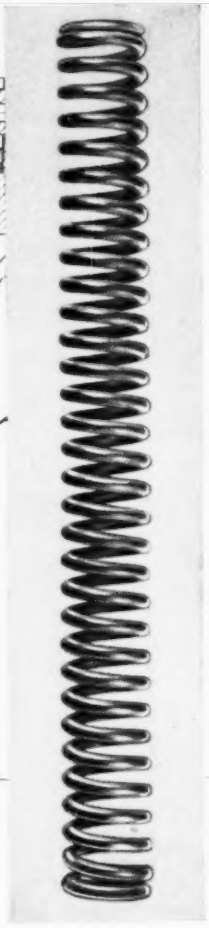

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ELECTRICAL TIMES

SARDINIA HOUSE, SARDINIA STREET, LONDON, W.C.2
Telegrams: Equivolt . Estrand Telephone: HOLborn 6016

Dans ce numéro

Dissipation de Chaleur dans les Eclairages Fluorescents 633

L'utilisation, dans des dispositifs fermés, d'équipement auxiliaire pour lampes fluorescentes, primitivement conçu pour être employé avec les dispositifs ouverts plus courants, demande que l'on accorde une attention spéciale à la dissipation de chaleur, en particulier, parce que cette fermeture fait pratiquement doubler la différence de température entre la lampe et l'atmosphère ambiante. Cet article contient une étude des températures que l'on enregistera le plus souvent avec des dispositifs à deux et à quatre tubes; ainsi que de l'effet refroidissant de l'armature métallique du dispositif.

Ligne de Transmission de 500 kV en Nouvelle-Zélande 638

Les ingénieurs conseils britanniques ont accepté l'utilisation du courant continu 500 kV pour établir une liaison de 620 km entre les deux îles de la Nouvelle-Zélande. Cette liaison inclue 40 kilomètres de câbles sous-marins. Ce système courant continu fonctionnera sur 250 kV à la terre, en utilisant des redresseurs à grilles commandées et des convertisseurs conçus pour une tension de groupe 125 kV, avec six anodes en parallèle pour une puissance de 1.200 amp.

Alternateurs Asychrones dans les Usines Hydrauliques 641

On a installé, en Ecosse, des alternateurs asychones, entraînés par des turbines à eau, dont les régimes vont de 30 kW à 5 MW. L'excitation de l'alternateur est obtenue à partir de la capacité du système, et la protection contre la surtension est nécessaire. Les machines n'ont pas de régulateurs de vitesse, et on les fait démarrer en ouvrant la commande d'admission d'eau de façon à atteindre une vitesse relativement voisine de la vitesse synchrone.

In dieser Nummer

Wärmezerstreuung aus Leuchtkörpern 633

Der Einbau in geschlossene Beleuchtungskörper von Leuchtstofflampen-Hilfseinrichtungen, die sich zuerst für den Einbau in die häufiger verwendeten offenen Beleuchtunskörper eignen, hat zur Folge, dass besondere Massnahmen erforderlich werden um einer Wärmestauung entgegenzwirken, zumal infolge des Abschliessens der Temperaturunterschied zwischen der Lampe und der sie umgebenden Luft auf etwa das zweifache erhöht wird. Der Artikel befasst sich mit den Temperaturverhältnissen, die bei geschlossenen Beleuchtungskörpern mit zwei bwz. vier Leuchtröhren auftreten können sowie mit der Kühlwirkung des Metallrückenteils.

500 kV-Uebertragung in Neuseeland 638

Die Verwendung von Gleichstrom mit einer Spannung von 500 kV für eine 620 km lange Verbindung zwischen den zwei neuseeländischen Inseln ist von britischen beratenden Ingenieuren gutgeheissen worden. Die Verbindung schliesst eine 40 km lange Unterseekabelstrecke ein. Die Spannung des Gleichstromnetzes gegen Erde würde 250 kV betragen, wobei gittergesteuerte Gleichrichter und Umformer zur Anwendung kämen, die für eine Gruppenspannung von 120 kV ausgelegt wären mit sechs parallelgeschalteten Anoden für eine Ausgangsleistung von 1 200 A.

Induktionsstromgeneratoren in Wasserkraftwerken 641

In Schottland sind bereits mehrfach durch Wasserturbinen angetriebene Induktionsstromgeneratoren (d.h. übertourig angetriebene Asychronmotore) mit Nennleistungen zwischen 30 kW und 5 MW aufgestellt worden. Die Erregung des Generators wird dem kapazitiven Blindwiderstand der Anlage entnommen und es entsteht dabei die Notwendigkeit, Vorkehrungen gegen Ueberspannung zu treffen. Die Maschinen besitzen keine Drehzahl-Regulatoren und das Anlassen erfolgt dadurch, dass die Beaufschlagung der Wasserturbinen so gesteuert wird, dass die Maschine auf annähernd die Synchrondrehzahl gebracht wird.

Heat in Fluorescent Lighting Fittings 633
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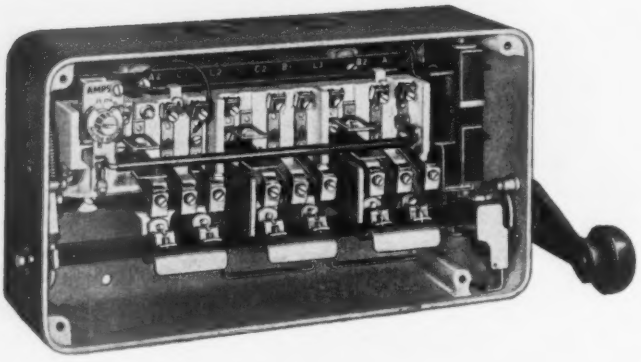
From the largest self-contained Switch-gear and Motor Control Gear plant in Britain comes a new "Memota" 25 h.p. Star-Delta Starter. Finished in stove grey enamel and lined with white insulating material, the coil and tripping mechanism are contained within the case; no external fixing lugs or hinges; three knockouts for 1¼" conduit; coil and magnet assembly easily removed for inspection or replacement.

Addition to the famous range



Other features include:—
Adjustable load indicator; positive no-volt release action, even with a fading voltage.

Laminated silver-copper fixed contacts; heavy gauge copper moving contacts, all readily accessible for inspection and cleaning.

Standard coil voltage 380-440.

Reliable bi-metal thermal overload trips enable full thermal capacity of the motor to be utilised and do not trip on overloads of short duration which are insufficient to damage the motor.

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ELECTRICAL TIMES

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Comment

SPENDING ON RESEARCH

DSIR's latest results on research spending carry a powerful warning for anyone who thinks that employment of a couple of scientists and engineers can give them a useful foothold in the fashionable world of research and development. They show that in 1958, for each professional scientist or engineer employed, firms in the electrical industry were spending nearly £7,500 a year. Moreover, the whole evidence of the survey is that expenditure per researcher is increasing, not just because more costly apparatus is being used, but because the need is being more widely recognised to back up qualified men with an ample staff of technicians and other helpers. In all of this they support the recent paper by Lord Nelson of Stafford. Yet despite such costs, the amount of research that industry as a whole is carrying out is shown by the survey to have increased considerably between 1955, to which the first of these DSIR reviews related, and 1958, now reported upon. The increase is the more striking because in this period the amount of research paid for by Government defence contracts was falling fast. The estimate put forward by the present report is that in this period expenditure on what may be distinguished as "civil" research and development more than doubled. For the electrical industry this has especial significance, for manufacturers in the electrical field shared with those concerned with aircraft no less than 80% of total Government expenditure on defence contracts. Indications elsewhere are that the increasing pace of electrical research has continued since 1958. The industry recognises clearly that although research is costly, it is vital to continued prosperity. The announcement this week that the AEI group, Parsons, and Reyrolle are to combine in research on heavy electrical plant gives these twin considerations topical weight.

INDUCTION GENERATORS IN SCOTLAND

Induction generators are to many engineers an idea appended to their studies of the induction motor, with marginal possibilities in small sizes. The work of the North of Scotland HEB with these exciter-less machines, described in an IEE paper last week, does much to remove any misconception. Generators with ratings as high as 5 MW are not small, nor is the aggregate contribution of 64 million kWh a year out of the total Hydro Board's generation of about 2,000 million kWh. However, it has to be accepted that the North of Scotland system is particularly well suited to these machines. The lagging megavar load they impose on the rest of the system in virtue of the magnetising current they draw is an advantage, since line charging current swamps lagging consumer load most of the time (though

a South Scotland speaker in the discussion was less happy—he thought Scotland should be considered as as whole from this aspect); and they can be used in penny packets to get energy from small statutory flows of compensation water that might otherwise be a complete loss to the hydraulic economy of the catchment areas. In the latter application, the chief electrical and mechanical engineer of the Hydro Board claimed that total generation costs can be as low as one-half or one-third of that for units in main stations, and if some speakers found this hard to accept, others adduced plenty of explanations for large savings. Indeed, the recurring question in a discussion which largely agreed that the induction generator is a good thing, was how far can the idea be carried? Although some speakers were optimistic about the practicability of big advances, it seems that the advantage of the induction generator comes so much through the simplicity of its control gear and operating techniques that it might prove difficult to maintain at ratings of some tens of megawatts.

NAVY STYLE MAINTENANCE

Documentation in maintenance is a theme frequently discussed in these columns; and one we are likely to return to, for a reasonable amount of work with the pen can save a lot of time with screwdriver and test lamps. It is not easy to point to breakdowns avoided as a result of close planning of routine attention, but once an installation exceeds a moderate size, the feeling of experienced engineers is that a scheduled scheme pays dividends. Amongst adherents to this view is the Royal Navy, as those who spent some time at the HMS *Hermes* exhibit at the Electrical Engineers' Exhibition may have discovered. The comprehensiveness of the planned maintenance documentation operated in connection with the complicated electrical installation of a large aircraft carrier must exceed what most factories could manage; but it should not be dismissed as yet another example of the Services' love of paper work. Such maintenance controls are troublesome to set up, and require vigilance to keep working, but they can pay off handsomely in relative freedom from breakdown and, in the evidence they give of weakness of design, that can help the electrical engineer to avoid buying trouble again when the time comes to place repeat orders.

NEW LOOK AT PEAK UNITS

Concentrated attention is being given by supply engineers throughout the world to the problem of cutting costs of peak generation. What methods are used depends much on local conditions; in the UK, pumped storage presents one of the more attractive propositions; in other parts of the world, with natural gas or low cost oil available, large gas-turbines are the immediate prospect. There is another approach now gaining ground in the USA, which is more closely related to established central station practice. Variously called "spinning capacity reserve" or "incremental generation," it is based on an extension of the old idea of making the most efficient rating of a turbo-generator something well below its maximum capability rating. A complex economic argument lies beneath this development, an argument that is founded on the belief that the rate of increase of thermal efficiency of large steam plants will be much slower in the immediate future than it has been over the past few decades. If this proves to be the case, then there will be less incentive to meet increasing loads by putting in new, higher-efficiency plant, and relegating relatively young sets to two- or one-shift operation. Existing sets might be kept at high load factor, and the general increase of load met by slightly less efficient machines incorporating as much as one-third overload capacity at much reduced efficiency. The trial calculations presented to support this idea suggest that initial kW capital charges for the incremental peak capacity that might be made available in this way could be as little as one-third of that for new high-efficiency capacity; but it is necessary to note that no machines of the new type have yet been fully worked out, yet alone built. There seems, too, more firm ideas for uprating boiler and turbine than for dealing with the generator to give it higher short-time rating.

WORLD-WIDE TIME CHECK

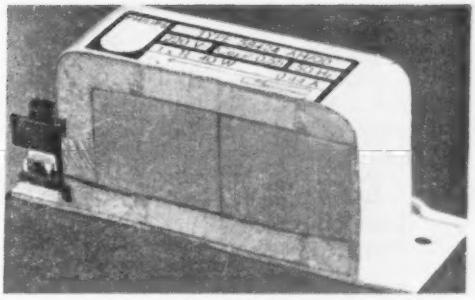
Time is a scientific quantity with which the electrical engineer is becoming increasingly concerned. His ability to construct devices that will keep time more steadily than the heavenly bodies on which the astronomer ultimately relies has introduced new problems into the whole business of measuring time; and now the requirements of space exploration have brought new complications. It is salutory for power engineers to study the complex arrangements announced last week for Anglo-American co-operation on global timekeeping, through synchronisation of time signals that have for many years been transmitted from official radio stations. The object is to emit time signals from five transmitters in synchronism to within one millisecond. Standard oscillators for this purpose will be calibrated in terms of the atomic vibration basis provided by caesium standards, with the behaviour of the American and British versions of this atomic reference the subject of further co-ordination by radio comparison. But this is not enough. The accuracy of this work will be too much for the astronomer's time check, and it is that which, nominally at least, is the foundation of the time measurement. So provision has to be made for adjustments at midnight at the beginning of each month to bring the stars and the atom back into line. The whole fantastic story of accuracy is, perhaps, summed up by the reminder that where high precision is required, it will, of course, be necessary to make allowance for the time lag between transmission and reception of the radio waves travelling at 290,000 km/sec.

Meteor

This week's quick summary of electrical news faces advertisement page 18.

Heat in fluorescent lighting fittings

by Th. Hehenkamp*



Section through a polyester filled choke

MANY low-pressure fluorescent lamps are mounted in fittings that do little to hinder the dissipation of heat from the lamps and ballasts. These include batten fittings in which the lamps are unshaded, or shaded at the sides only, and industrial fittings with plain or perforated reflectors, open at the bottom. Since these fittings are in the majority, it is not surprising that most lamps and ballasts are designed for use in them. But, as a result, temperature problems arise when they are used in the more restricted, but none the less important, field of enclosed fittings. These problems are in the province of the fitting designer and the architect who must see to it that no undesirable consequences arise from the inadequate cooling of lamps and ballasts. Certain aspects of this matter will now be dealt with in more detail.

Effect of Higher Temperatures on the Lamp

Most low-pressure fluorescent lamps are dimensioned to give maximum luminous flux when freely suspended in an ambient temperature of between 20°C and 25°C. The coolest point on the wall of the lamp then is about 40°C. At this temperature the pressure of the mercury vapour inside the lamp is an optimum from the viewpoint of light yield. At higher ambient temperatures, or when the cooling of the lamp is less efficient, the wall temperature rises and the luminous flux falls in consequence (Fig. 1).

A high ambient temperature has little effect in itself; in tropical countries the temperature of the air will seldom exceed 40°C and, even then, the light loss will still be less than 10%.

Inadequate cooling of the lamps may have more serious consequences. In small enclosed fittings the lamp temperatures may rise to 30°C or 40°C above normal and such temperatures may lead to light losses exceeding 20%, even if the lamp watts are kept constant, but a high lamp temperature is normally accompanied by a fall-off in lamp watts, owing to a drop in the voltage across the lamp, and this results in a further decrease in luminous flux. High lamp temperature has, therefore, a doubly adverse effect, the extent depending on the characteristics of the ballast used.

Figs. 2 and 3 show the effect of temperature on lamp characteristics for two of the more conventional types of gear. Fig. 2 shows that a temperature rise may result in an increase in the discharge current, and so (Fig. 4) shorten the life of the lamp, as well as increasing the load on the ballast.

For these reasons it is essential that adequate cooling be provided in enclosed fittings designed for surface or flush mounting in ceilings.

Effects of Temperature on the Ballast

High ambient temperature has only one important effect on ballasts; to shorten the life of the components. Not all components making up a ballast are affected in the same way. Capacitors must be dealt with differently to chokes and transformers, which are on the same footing insofar as temperature effects are concerned.

Chokes and Transformers

High temperature rapidly ages the electrical insulation of these components; the higher the temperature, the quicker the deterioration. This shortens the life of the choke, and there is a well-known relationship between choke life and temperature.

Fig. 5 shows this relation for two types of choke. The

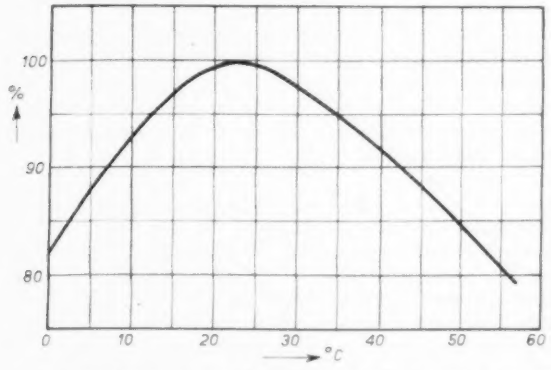


Fig. 1. Graph showing rise and fall of luminous efficiency with tube wall temperature, the optimum efficiency being at between 20° and 25° C

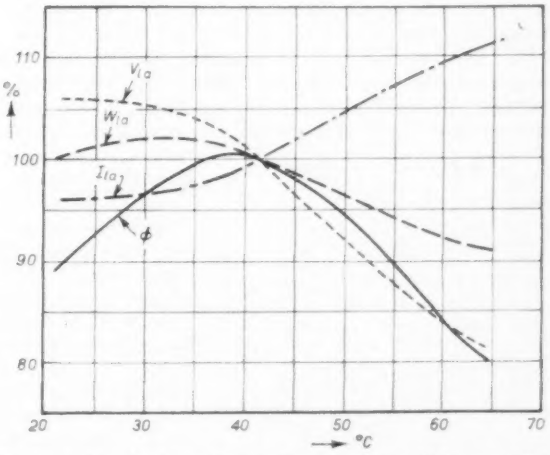


Fig. 2. Graphs showing relation between lamp volts (V_{la}), watts (W_{la}) and current (I_{la}) with temperature on a conventional ballast unit

* Mr Hehenkamp is with N.V. Philips Gloeilampenfabrieken-Eindhoven.

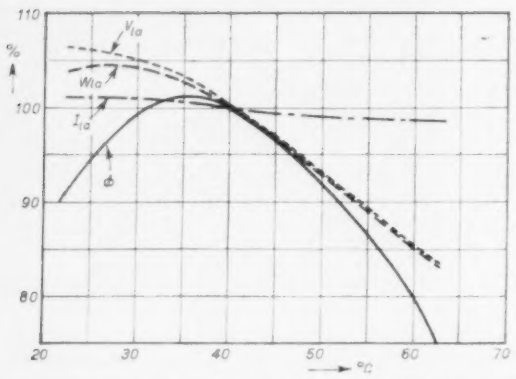


Fig. 3. Graph similar to Fig. 2 but with an alternative type of ballast unit giving cooler operation at a sacrifice of luminous flux

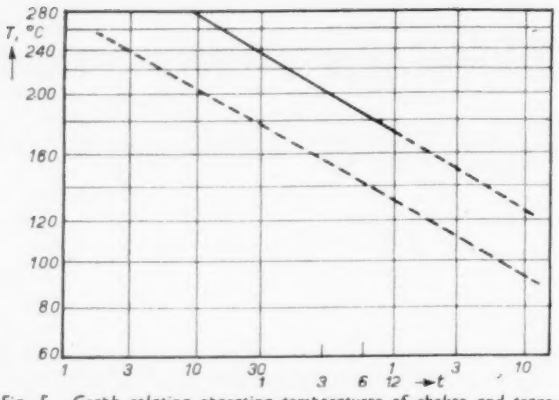


Fig. 5. Graph relating operating temperatures of chokes and transformers to average expectation of life (t) for two types of design

insulation temperature is the sum of the ambient temperature, the temperature rise at the surface of the choke (i.e. rise above ambient) and the temperature gradient inside. The latter two effects are due to losses in the choke. Normally ambient temperature is beyond the designer's control but he can do a great deal to ameliorate the rise in surface temperature and the internal gradient by mounting the ballast in the fitting in such a way that the heat is efficiently transferred to the latter and from thence to the surroundings. The temperature drop can be increased by having as much as possible of the surface area of the ballast in metallic contact with the fitting while careful placing of the components within the ballast also helps. All of these measures can be adopted to promote long choke life.

They would be less important if chokes could be designed for a smaller temperature rise but generous dimensioning has serious economic implications for the weight of a choke is inversely proportional to the rise in the insulation temperature, other things being equal. An appreciably cooler choke would, therefore, weigh and cost more.

Capacitors

The life of capacitors is also prejudiced by high temperatures. The connection between the two is more complicated and less is known about it than about the connection between choke life and temperature. In general, capacitor life may be expected to decrease by 80% for every 10°C rise in the temperature range of interest for present purposes.

The life of capacitors at high temperatures can be lengthened by increasing the dimensions. This means reducing the field strength in the dielectric, a most uneconomical proceeding, since the dimensions of the capacitor are roughly inversely proportional to the square of the field strength. For both classes of component, then, higher temperatures mean reduced useful life. Hence efficient cooling is of the highest importance for the alternatives are unnecessarily expensive ballasts or excessively short life.

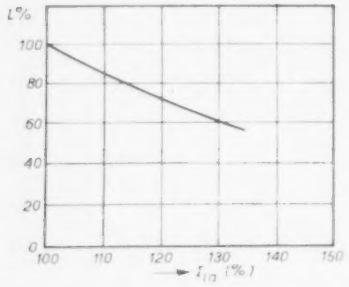


Fig. 4. Graph relating lamp life with increase in lamp current (I_{la})

Ballast Design

It is usual to enclose all the components of a ballast in a steel plate box. This has several advantages, the most important of which are: (a) neat appearance and effective protection for components and wiring, (b) the stray magnetic field of chokes and transformers is screened by the metal case, reducing the possibility of vibration and noise by magnetic effects in parts of the fitting, and (c) the box makes it easier to mount the ballast in the fitting in such a way as to satisfy heat-transfer requirements.

Provision must be made within the ballast itself to dissipate the heat generated in the chokes and transformers. To this end, spaces between the components and the walls of the box may be filled with a substance that is a good conductor of heat and polyester-based resin fillers are particularly suitable for this purpose. Not even the best filler has negligible thermal resistance, however, and the gaps between components and case must be as small as possible. Capacitors do not give off much heat and there is no need to provide for conduction to the container. On the contrary, they should be insulated from it as much as possible, since the walls themselves are heated by the chokes and transformers. The capacitor temperature can be considerably reduced by leaving a large air gap between the capacitor and these components.

Fittings Design

A design of a fitting which may entail high lamp and ballast temperatures must provide for efficient drainage of heat from both lamps and ballasts.

About 20% of the power consumed by a fluorescent lamp is radiated as light, the remaining 80% being dissipated as heat. When the lamp is freely suspended in air, radiation and convection each account for about 40%. If the lamps are totally enclosed by the fitting, convection will be inhibited and the lamp temperature will rise. It is difficult to calculate this temperature rise with any degree of accuracy but it can be determined by experiment.

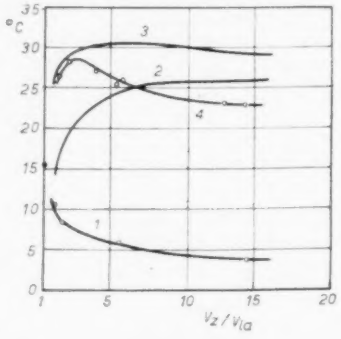


Fig. 6. Graphs showing how cylindrical enclosed tube temperatures (2, 3, 4) compare with open tube temperatures

An approximate value of the rise calculated for a lamp enclosed in a concentric transparent cylinder is shown in Fig. 6. It has been assumed that the cylinder wall has a thickness of 2·5 mm and that no convection takes place in the air enclosed by the cylinder. The plotted temperatures relate to the middle-lower side of the lamp, as this is the coolest place and governs mercury vapour pressure in the lamp.

The temperature of the lower half of the lamps is much the same over the centre part of its length but is higher at the ends where heat dissipated by the electrodes is concentrated.

Fig. 6 reveals that the effect of the enveloping cylinder is roughly to double the temperature difference between lamp and ambient; the calculations indicate that the rise in lamp temperature is little dependent on the volume of the cylinder. In point of fact, lamp temperatures begin to decrease when the volume of the cylinder is increased, because of convection in the enclosed air space (see curve 4 in Fig. 6).

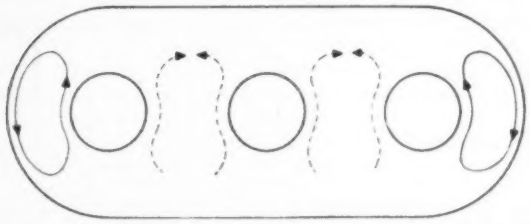


Fig. 7. Flow of convection currents in enclosed multi-tube fitting

All that one can do to restrict lamp temperature in completely enclosed fittings is to make the enclosure of liberal dimensions. The situation in a multi-lamp fitting is even more unfavourable (Fig. 7). First, convection in the space between two lamps is handicapped to a considerable extent since convection currents caused by one lamp collide with those created by its neighbour. In addition, the radiation from any one lamp includes one or two other lamps at roughly the same temperature; consequently dissipation by radiation is restricted to a small part of its circumference. These limitations on radiation and convection cause the lamps in an enclosed two-lamp fitting to become 20% to 40% hotter than lamps in a single tube fitting. Lamp temperatures can be minimised only by increasing the size of the fitting; a compromise has, therefore, to be found between size and price requirements on the one hand and lamp temperatures on the other.

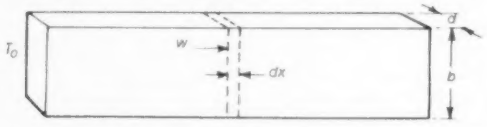


Fig. 8. Schematic diagram to illustrate thermal drainage calculations

Drainage of Heat from Ballasts

The ballast is a good deal shorter than the lamp and it constitutes a localised heat source in the fitting. Convection and conduction via the air normally play very little part in the removal of heat from ballasts; transfer has to take place by radiation and by conduction via metal parts.

All surfaces that can act as radiators must be as "black" as possible for the long-wave infra-red range. Their radiating properties can easily be improved in this respect by giving them a coating of non-metallic paint, the colour of which is of little importance. In the majority of cases it is conduction via metal parts that contributes most to the removal of heat and the conductive properties of such parts should be exploited to the utmost. The ballast is attached to the fitting in such a way that a large area of the metal case is in clean contact with one surface of the fitting, preferably a surface otherwise entirely exposed to the outside air. The lower the internal resistance of the ballast and the closer the contact the ballast makes with this surface of the fitting, the less steep is the temperature gradient between the interior of the ballast and the fitting.

There is a further temperature gradient between the fitting surface and its surroundings and this depends upon the shape and dimensions of that surface, which also acts as a cooling fin. Calculations and measurements show that a metal plate of quite modest dimensions can constitute an effective cooling fin. Let us consider a strip of metal (Fig. 8) of width b and thickness d, one end of which is maintained at a temperature T_0 higher than the ambient temperature, and assume that the strip dissipates the acquired heat from one side only. (The reverse side is generally inside the fitting, where it faces parts at roughly the same temperature.)

Let the temperature drop created across an element δ by a thermal current W be

$$T = \frac{W \delta x}{bd\lambda}$$

In approximation, the element of area bdx dissipates heat to the surroundings at the rate

$$W = KbT \delta x$$

From this it follows that

$$\frac{\delta^2 W}{\delta x^2} = \frac{K}{d\lambda} = W$$

and

$$\frac{\delta^2 T}{\delta x^2} = \frac{K}{d\lambda} T$$

If the heat given off by the small area bd at the end of the strip be disregarded, the boundary conditions are

$$x = l\,;\ W = 0$$

and

$$x = 0\,;\ \frac{\delta W}{\delta x} = KbT_0$$

From these equations one can determine the quantity of heat that can be drained by a given cooling fin and also the temperature distribution along the fin.

Figs. 9 and 10 show heat transfer and temperature distribution curves, as calculated, for certain fin lengths and materials. These curves can be used in straightforward cases to calculate the cooling effect achieved by attaching the ballast to the fitting.

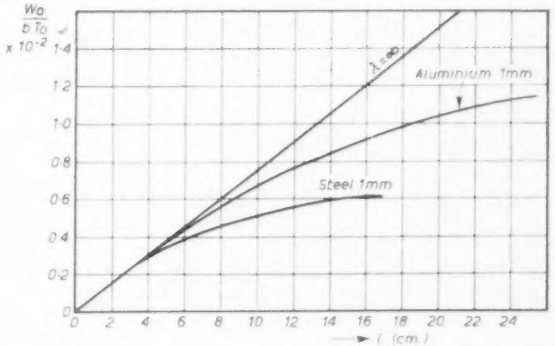


Fig. 9. Heat transfer graphs for aluminium and steel fins of different length but of the same thickness

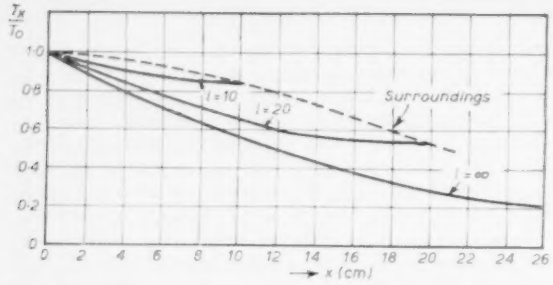


Fig. 10. Temperature distribution graphs for aluminium cooling fins of different length but of the same thickness

Let us, by way of example, take a ballast of 10 cm length, dissipating 10 W and fitting exactly into the cross-section of the channel in which it is mounted (Fig. 11). The channel is attached to a ceiling to which heat cannot be transferred; radiation can only take place through the sides and lower face of the fitting. The temperature rise of the surface of the ballast will be as in Table 1, depending on the length of the channel.

Table 1

Length of channel in cm	Painted 1 mm steelplate: Temperature in °C	Painted 1 mm aluminium: Temperature in °C
10	53	53
30	29	26
40	27	22
60	26·5	19
120	26	18

Relatively short steel plate channels give good results, but increasing the length of the channel does not improve matters very much. Short lengths of aluminium show no great improvement on short lengths of steelplate of the same gauge, but the effect of the higher conductivity of aluminium becomes more evident as the channel is increased in length.

The lengths in Table 1 have been chosen in such a way that, for a 4 ft lamp, the lower four pairs of temperature values are applicable (assuming correct ballast distribution in the space available in the channel) to 4, 3, 2 and single lamp units.

It is not so easy to carry out calculations of this kind for complicated types of fittings though, in many cases, it is possible to arrive at a rough estimate of the reduction that can be effected in the surface temperature of the ballast unit casing.

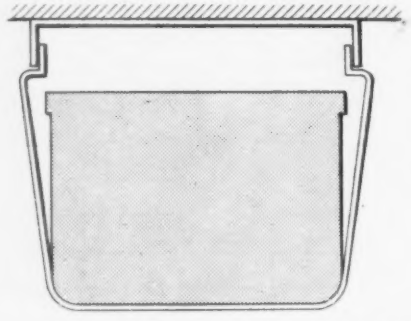


Fig. 11. Cross-section of ballast in enclosed channel fitting

Let us now try to clarify the above observations by applying them to practical examples. The first example is the enclosed two-lamp fitting shown in Fig. 12.

Two inductive ballasts, each dissipating about 11 W

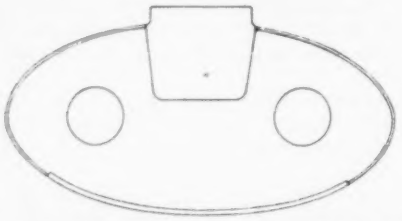


Fig. 12. Cross-section of twin lamp enclosed lighting fitting

when warm and under the rated load, are mounted in a channel of the same length as the lamps. The channel also carries the lamps, is fitted with two metal side-pieces and, at the bottom, a pane of translucent plastic. Numerous small holes made in the side-pieces throw part of the light onto walls and ceilings but have been covered

Table 2

Stage of Assembly	Δ t Lamp		Δ t Ballast	
	Estimated °C	Measured °C	Estimated °C	Measured °C
Channel only, with two lamps	16	16	29	28
Fitting complete	31	31	44—49	47.5

with transparent lacquer to make the fitting dust-tight. From the viewpoint of cooling it can be described as a completely enclosed fitting. The volume enclosed is 9·5 times that of the two lamps combined. Fig. 6 shows that, in these circumstances, the lamp temperature will rise to about 1·3 by 24°C above ambient temperature, causing the lamp current to fall off by 7·5% and losses in the ballast to increase by about 15%. Table 1 would indicate that the temperature of the ballast surface will rise to about 34°C above ambient but to this we must add a further 10 to 15°C since it is the warm air inside the fitting, not the outside air, that surrounds the lamps.

In Table 2 temperatures actually measured with the fitting in two stages of assembly are compared with the estimated temperatures.

The second example is a four-lamp fitting with a honeycomb diffuser made of plastic (Fig. 13). Four ballasts have been correctly distributed in the mounting channel which is shielded on all sides by steel plate walls. Measurements on this arrangement, in two stages of assembly, as also on variant arrangements built specially for the purpose are shown in Table 3.

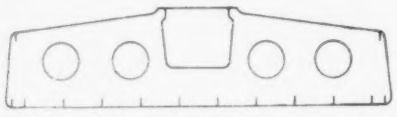


Fig. 13. Cross-section of four-lamp louvred fitting

This table clearly reveals how progressive walling-up of lamps and ballasts affects their temperatures. So long as the fitting is open, allowing the passage of a stream of cooling air, lamp and ballast temperatures remain low and

are but little affected by the presence of the honeycomb. Shutting off the top of the fitting reduces convection and more heat has to be removed by radiation, so temperatures rise. The effect on the honeycomb is now greater, because part of the heat radiated is transferred to its heated surfaces. Finally, completely shutting off the bottom of the fitting means that convection is almost entirely eliminated; heat can only be transferred by radiation onto neighbouring surfaces which are hot in any case. It is the ballast temperature that undergoes the most marked rise resulting in a large increase in lamp current.

Table 3

Experiment No.	Arrangement measured	Δ t Lamp		Δ t Ballast	
		Estimated °C	Measured °C	Estimated °C	Measured °C
1	Channel fitted with ballasts under normal load, 10·5 W	—	—	30·5	28·5
2	Ditto with lamps	18	18	—	—
3	Complete with sidewalls and honeycomb ...	—	21	—	40·5
4	Top cover without honeycomb	—	26·5	—	42
5	Top cover with honeycomb	—	33	—	55
6	Pane of plastic instead of honeycomb ...	42	44·5	60-65	68

Both examples give a good idea of the difficulties that fitting designers have to overcome. Provided that the design permits the passage of air, temperatures remain fairly low; but such a design will also permit dirt to enter, which again means a loss of light. If the fitting is completely enclosed to reduce soiling, light will be reduced on account of higher temperatures. However, the loss can be kept within bounds by correctly exploiting the principles of heat theory and giving the fitting appropriately large dimensions.

Flush-mounting in Ceilings

The designer of pendant-hung fittings, or fittings for attachment to ceilings, is in a position to decide for himself what measures will be necessary to solve the heat problem. It is not so easy when a fitting is destined for flush-mounting in a ceiling, for the heat-transfer conditions that will obtain are not cut and dried, being dependent on the nature of the ceiling. This is in the sphere of the architect who, when designing ceilings in which fittings are to be flush-mounted, must accordingly take into account heat-transfer as well as purely structural requirements. Narrow recesses in which air movement is restricted may undo all the good that the fitting designer has done; the architect must allow for drainage through the top of the fitting and, preferably, through the ceiling as well. Where double ceilings are built for insulation, thermal or acoustical, they must be cut away where the fittings are to be accommodated or heat-transfer will be particularly inefficient if the double layer is continued above the fittings. There must, therefore, be close co-operation between architect and designer of flush-mounting fluorescent fittings.

TELECONTROL FOR PUMPING STATION

ONE of the most interesting features of the new pumping station and treatment works recently inaugurated by the River Dove Water Board at Melbourne, Derbyshire, is the remote telemetering and control system. This centralises supervision of the distant, unmanned pumping stations over GPO lines specially rented for the purpose.

There are three pumping stations in all. The intake station, situated near the confluence of the Rivers Trent and Dove, extracts water from the Dove and pumps it to the treatment works at Melbourne, eight miles away. The high lift station is located adjacent to the treatment works and is coupled to the control desk by direct wire connections. Five miles on, at Belton, a booster station helps the flow along to the distant town of Leicester.

Telemetering from all three stations, as well as control of the starting and stopping of the pumps, is by equipment designed, manufactured and installed by the Instrumentation and Control Division of Standard Telephones and Cables Ltd. The system, which is transistorised, employs two-way, 12-channel frequency-shift modulated carrier telegraph systems for both control and telemetering signals to and from the intake station to which it is connected by a four-wire telephone line. The control is effective over one variable speed and two constant speed pumps and a rotary screen with provision for future duplication of the pumping plant. Telemetering signals are in the form of interrupted tones, the speed of interruption being proportional to the measured quantity. These metering signals cover pump speed, motor speed and pumping rate for each set, delivery head, river and sump levels and, finally, river flow. The signals are decoded and presented in recognisable form on the meters of the control desk.

Communication with the Belton station is by a two-wire GPO line, where control and continuous indication of pumping rates are transmitted in the form of superimposed control signals on a 50 cycle carrier, derived from the a.c. supply, for each of the two pumps.

The desk-type control panel incorporates provision for extensions to the system, including control of an extraction pumping station which will come into action when the Staunton Harold reservoir, located close to the works, is completed.

Station superintendent at the remote control panel in the Melbourne treatment works

Design for Cook Strait

TECHNICAL CONSIDERATIONS FOR NEW ZEALAND PROPOSALS

IF the project for 500 kV d.c. transmission in New Zealand is embarked on as a result of the consultant's recommendations reviewed in these pages last week, the design work associated will involve much breaking of new ground. The report by Messrs Preece, Cardew and Rider to the New Zealand Electricity Department does not cover design in any detail, but it reviews the probable form of the scheme, and remarks on the present state of h.v. d.c. technique.

Equipment

The scheme recommended by the consultants is shown in the simplified circuit diagram of Fig. 1. So far as the overhead line is concerned, the suggestion is that it would be run on lattice steel towers carrying two sets of duplex s.c.a. conductors, one set on each side of each tower. Two overhead earth wires would be provided to give lightning protection. The line route envisaged climbs to considerable heights; although 170 miles lies below 1,000 ft, there is 135 miles over 2,000 ft with heights of 3,400 ft a few miles from the Benmore generating station and 3,850 ft at the highest point. At elevations above 3,000 ft, practice with a.c. lines is to base design on $\frac{1}{2}$ in. radial of ice.

It is thought that the insulation distance needed on the lines for 250 kV to earth should be about the same as that for 230 kV to earth with a.c. (400 kV between lines). Internal over-voltages are likely to be less with d.c. than with a.c., in the ratio 1·7: 3 times normal.

The report does not discuss in detail the design of the submarine cables to be used in the Cook Strait crossing, but is assumes two cables and one spare (gas-filled type).

So far as the converter substations are concerned, estimates have been based on the use of a group voltage of 125 kV, with six anodes in parallel for an output of 1,200 amps. This compares with 100 kV and four anodes in parallel for 800 amps proposed for the cross-Channel d.c. link, the converters for which have been designed and tested in prototype form. The report on the New Zealand scheme notes that the manufacturers, ASEA, are confident that the development work necessary to give the proposed Cook Strait crossing ratings should not be over-difficult.

One of the advantages of the d.c. system is the possibility of operating it in an emergency as an earth return system, to maintain 50% transmission capacity. To permit this, special care will have to be taken with the siting of the earth electrode installation, to avoid damage to structures belonging to third parties, but it is thought that this can be managed without undue difficulty. Equipment will also need to be installed to reduce interference with radio and television circuits.

Operation

One of the principal criticisms that the plan for d.c. met was that it represented too large a risk to North Island power supplies. Detailed studies have been made of this point from two aspects: that of the effect of loss of supply, and that of the availability to be expected from the d.c. equipment.

Probable system conditions in 1966-67 were considered in the calculations of the effect of loss of supply. North Island load by then is estimated as about 1,600 MW, with 1,400 MW installed capacity. For transient faults, in which d.c. power input of 35% of North Island load was lost, the critical time for restoration of the d.c. supply would be $\frac{1}{4}$ sec. For longer interruptions, if the power input lost was less than 12% of the load, then the system would reach a new equilibrium condition. For higher percentages, it is suggested that some form of time-delayed rate-of-change-of-frequency load shedding control should be installed to prevent excessive falls in frequency.

Regarding availability, there is only the Gotland record to go on. This is discussed at length, but the feeling seems to be that they can only provide a rough guide due to several special considerations. In particular, the New Zealand scheme as at present envisaged should be simpler of control. Over-all the position is summed up as follows: although with a d.c. connection rather more frequent disturbances are probable than in the case of an a.c. scheme, the former has the advantage that in the great majority of instances the disturbances would be of a nature causing only temporary restrictions of transfer capacity and not total interruption.

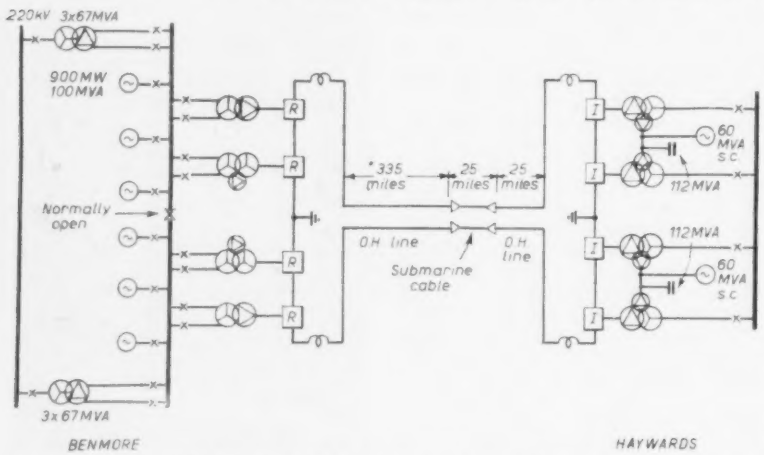


Fig. 1. Proposal for 500 kV d.c. link. The d.c. lines are duplex 0·15 sq in/pole, the submarine cable conductors 0·85 sq in. Generation at Benmore is at 18 kV. The a.c. connection at Haywards is at 110 kV and feeds into the North Island transmission system

Aluminium strip production

NEW MILLION POUND ROLLING MILL STARTS WORKING

THERE is always a particular satisfaction in achieving what others claim to be the impossible, especially when the "others" happen to be our American contemporaries. Moreover, when the process in question, applied to a million pound project, is successful in avoiding the necessity for a companion project costing at least twice as much, that satisfaction can pardonably be tinged with pride.

These feelings must have been uppermost in the minds of all who contributed to the design and erection of the new Sendzimir 50 in. aluminium strip mill as it was set in motion by the Marquess of Exeter, K.C.M.G., chairman of Birmid Industries Ltd., on 7 April. The million pound project included, as an extension to the existing Woodgate Works, Quinton, the 50 in. reversing mill, two annealing furnaces, a welding line, slitting and cut-to-length lines together with auxiliary equipment, motors and control gear.

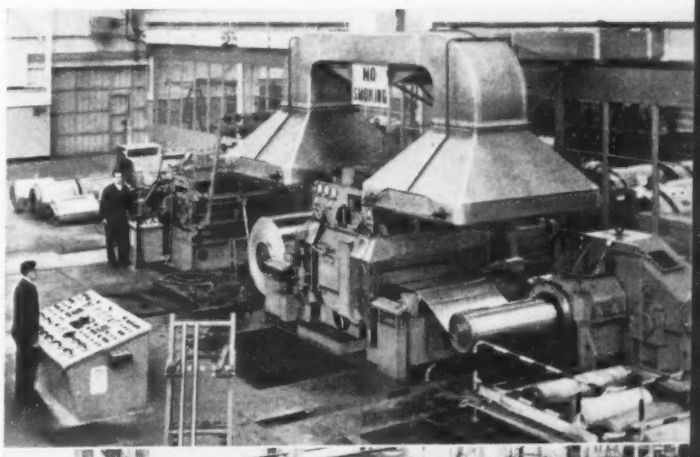
The 50 inch Reversing Mill

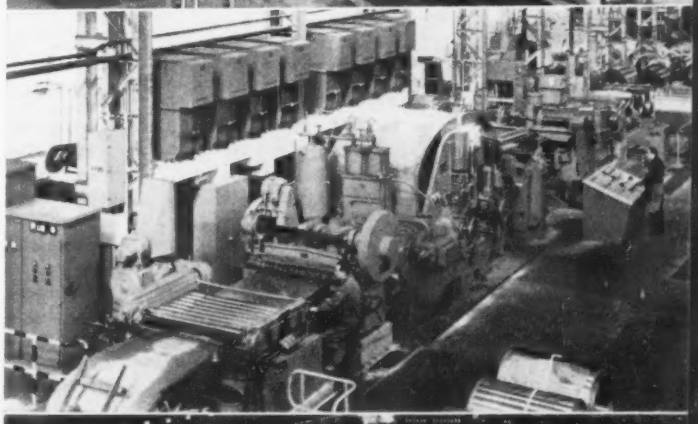
The 50 in. Sendzimir reversing mill is claimed to be the first in Europe to produce continuous strip aluminium or alloy in trimmed width up to 48 in. and thicknesses from $\frac{3}{16}$ in. down to 0·006 in. at speeds up to 1,600 ft/sec. Ultrasonic measuring devices monitor the thickness and electronic control ensures that the required close limits are maintained throughout the length of the strip. Uniform thickness across the width is maintained by precision-ground rolls which, incidentally, can be changed within 30 seconds. The mill will take an unbroken coil of up to 10,000 lb in weight, but in the initial stages this is being kept down to 8,000 lb.

Two 900 h.p. d.c. motors in tandem drive the rolls while the draw winders are driven by three 350 h.p. d.c. motors to provide a tension of up to 25,000 lb. All of the motors are supplied from four generators coupled to an 11 kV, 3,500 h.p. motor with Ward-Leonard control, and motors, generators and control desks were manufactured by the Heavy Plant Division of AEI at Manchester.

Electric Furnaces

Two furnaces, one for coil annealing and one for sheet annealing, are also included in the scheme. The former, supplied by Stordy Engineering Co., is rated at 500 kW and has a capacity of 8,000 lb/hr, the high temperature zones being regulated at 450°C. By routing ingoing coils in adjacent chambers to outgoing coils, from which they extract some of the heat, the electrical loading is only a little over half that for orthodox batch annealing. The sheet annealing furnace, made and installed by G.W.B. Furnaces Ltd., has four heating zones with an over-all loading of 600 kW.





Top, the Sendzimir strip rolling mill which operates at a maximum draw-off speed of 1,600 ft/min. Centre, the welding line with, left of the control panel, the special butt welding unit. Below, the mill motors and motor generators in the pressurised, air conditioned motor room surrounded by the AEI (Manchester) switchboard

The Welding Line

It is, however, in the welding line that the major success has been achieved. The mill takes its initial coils from a four high rolling mill in the adjacent works, the output capacity of which is limited to 2,000 lb coils up to 52 in. wide. This represents about 20% of the capacity of the new strip mill, and to provide coils of five times this weight would have necessitated additional hot rolling, ingot and slab-casting capacity which would certainly have cost at least another £2 million. When the engineers suggested that it might be possible to electrically butt-weld 2,000 lb coils together prior to passing through the mill, it was confidently asserted by American contemporaries that the idea was not practicable.

The company's technicians, however, were equally confident that the scheme was possible and the company had sufficient confidence in them to give the order to go ahead. The results have completely justified that attitude and the new welding line is now butt welding adjacent coils with perfect consistency in a machine which is probably unique in its class.

The welding machine, which forms a central unit of the welding line, was designed and made to the company's specification by A.I. Electric Welding Machines Ltd. There are two steps in the process, a flashing period lasting about three seconds when the two edges are brought together, and during which the electrical load is 290 kVA, and a forging process when the weld is consolidated, during which the load rises to 2,320 kVA for about one-seventh of a second. The latter value would have been nearly doubled had it not been for the use of capacitors, since the load is essentially at a poor power-factor. As it is, the peaks can be absorbed by the supply system without noticeable flicker of the lighting. The drives to the machine are by d.c. motors through a Ward-Leonard motor generator set which, together with the control desk, was supplied by the English Electric Co. Capacitors for power-factor correction were supplied by the Static Condenser Co. and step-down transformers by the Gresham Transformer Co. Motors and motor generator sets for the cut-to-length line conveyors were also of English Electric manufacture.

Rolling mills and associated machinery of this type require a constant flow of oil in large quantities which must be cooled during circulation. In the new plant accommodation for 16,000 gallons of oil has been made in a cellar beneath the building, which is circulated at a rate of some 700 gallons per minute. This cellar is part of the foundations of the building, the floor area of which is about 45,000 sq ft, and required no less than 2,500 tons of concrete and reinforcement.

The consultant on the subject of electrical supply problems in connection with the welding machine was R. B. Giles, M.I.E.E., M.CONST.E., M.A.I.E.E.

Ground control of air traffic

SAFETY in the air, particularly in the vicinity of busy airports, is as much due to the highly organised ground control organisation as to the skill and alertness of the individual aircraft pilots. In fact, when visibility is low, the pilot relies almost entirely on "Ground Control" for avoidance of collisions and for his positioning and run-in to a landing. Even when he is safely on the glide-path and receiving his marker beacon signals, it is Ground Control which ensures that other aircraft are clear of his course.

With aircraft landing and taking off every few minutes and with others circling and awaiting their turn, the responsibility of the Ground Controller and his assistants is onerous, to say the least of it, since it involves the location and altitude, identification and routeing of every aircraft in the area continuously and the passing of messages, which must not be capable of misunderstanding, in rapid sequence to the pilots awaiting their turn. They must be in constant touch with the controllers in adjacent traffic lanes—and there may be several radiating from a single airport—and they have the additional responsibility of transmitting flight plan information provided by the pilot shortly before take-off to the controllers along the route and at the other terminus. Conversely, they must receive similar information from airports despatching aircraft to them and have to integrate the incoming traffic into their plan.

Since these responsibilities involve a great deal of calculation which has to be visualised in a three-dimensional space pattern and with time intervals shrinking as aircraft speeds increase, recourse to electronic calculating machines is an inevitable step. Radar is, of course, an invaluable aid but, at the best, it only gives a two-dimensional presentation and, even though it is used to reduce the longitudinal separation between aircraft to five miles for short periods, the unexpected and unheralded arrival into the area of an off-course military jet travelling at 600-700 m.p.h. leaves an incredibly short interval in which to take any action.

Modern developments for the handling of high density airport traffic and the efforts of the technical engineers in the electronics industry to devise equipment for relieving the Ground Control staff of as much of their burden as possible were discussed at a symposium organised by the IEE at London on 8 April. The afternoon session was concerned with the subject of flight information processing and the papers were prepared and read by the authors, members of the Ministry of Aviation and Standard Telephones and Cables, etc. These covered the requirements of modern air traffic control and the efforts which were being made to bring the information to the flight controllers' desks in the shortest possible time and in a form requiring the least calculation on their part. Experimental computing systems in use both in Britain and in Holland were described and, for the pilot in distress, an automatic position-finding system based on wartime triangulation techniques, which only required a short duration signal to establish the position within reasonable limits of accuracy.

The evening session discussed a number of papers on the subject of basic computer designs as applied to flight control systems and their integration into modern radar presentation for the benefit of the controller and his assistants. The bulk of this specialised research is currently being carried on by the Radar Research Establishment and the Royal Aircraft Establishment in close co-operation with the manufacturers of the equipment.

Induction generators on North of Scotland system

OPERATING CHARACTERISTICS REVIEWED IN I.E.E. PAPER

INDUCTION generators are less expensive than synchronous machines, and can operate with simpler control arrangements and auxiliaries. Their characteristics make them particularly suitable for use on the North of Scotland HEB system, and the board's chief electrical and mechanical engineer discussed the use made of them in a paper* presented to the IEE supply section last week.

In essentials, the induction generator is an induction motor driven at above the synchronous speed of the system to which it is connected. The shaft power supplies the machine's losses and its power output, while the magnetising current is supplied from the system. The source of the reactive current for magnetisation may be synchronous generating plant connected to the system or capacitance inherent in the system.

Over-voltages

One of the difficulties associated with induction generator operation arises from this last possibility. If a generator which is running on load is disconnected from the part of the system absorbing its power output, but remains connected to an overhead line or cable, then a self-exciting system can be created, provided the line or cable can supply a large enough capacitative current. In such a circumstance there is no effective control of voltage, for loss of load will lead to a rise in machine speed, and the consequent increase in frequency will bring an increase in the capacitative current. Tests carried out on a 350 kW induction generator connected to 15 miles of 33 kV line have demonstrated this. (Line phase capacitance, 0·225 microfarad.)

Fig. 1 shows the results obtained from these tests, which were carried out with consumers disconnected from the line. It is felt that in practice, with the consumers left connected, the voltage rise would be smaller than shown—but the need for protection against excessive speed and voltage is apparent.

Magnetising Current Effects

Another problem that has been the subject of test investigation is the accuracy needed in speed control when first switching the induction generator on line. Switching the stator onto the system causes a transient magnetising current of magnitude several times full-load. The conclusion from tests on a 2·4 MW machine is that errors of speed matching of −5% to +10% from synchronous speed are not of great importance and have little influence on the transient effects of switching-in on the system to which the generator is connected. This is explained by considering the induction machine as equivalent to a transformer with a short-circuited secondary winding, the reactance of which is practically independent of speed.

That induction generators impose a lagging load on the system they supply has already been mentioned. In Scotland this is usually an advantage, for the system has a high proportion of line charging current. This characteristic arises from the comparatively high mileage of 132 kV lines in relation to load. At night, when there is relatively low export from the north to the south of Scotland, the problem of keeping down voltage is considerable. Some 132 kV lines have to be switched out, and up to 50 MW of generators run under-excited as synchronous reactors. Table 1 illustrates this situation. One further effect

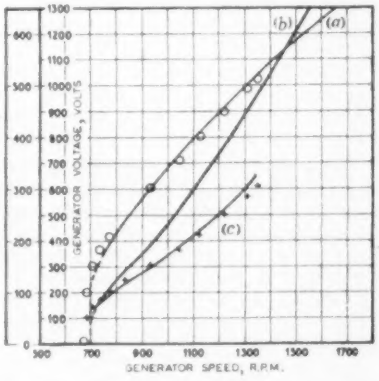


Fig. 1. Induction generator excitation tests with 350 kW machine connected to 15 miles of 33 kV line through 500 kVA transformer. (a) Speed/voltage curve, calculated and test figures; (b) speed/current curve for transformer h.v. side (calculated); (c) speed-current curve for current at generator only, calculated and test figures

Table I. Reactive power on N of S HEB System

	Daytime		Night-time	
	Summer	Winter	Summer	Winter
Generator synchronous power MW	500	870	55	85
132kV circuit length miles	1,500	1,593	1,270	1,312
132kV line-charging power MVA	126	137	110	113
System load lagging reactive power MVA	110	190	12	18
132 transformer magnetising power MVA	32	35	30	30
Induction generator magnetising power MVA	11	12	4	6

of the magnetisation requirement of the induction generator is that its active power is effectively delivered at leading power factor, so there is a reduction in voltage drop, and to some extent a voltage rise along the transmission system. This is accompanied by increased copper losses on the system.

Control and Commissioning

Induction generators are usually run at steady load, so simple arrangements for varying the admission of water to the turbine are acceptable. Speed-sensitive governors are not used, since machine load is steady, and switching

* Paper No. 3140: Water-Turbine-Driven Induction Generators, by C. L. C. Allan, B.A., M.I.C.E., M.I.E.E.

in at a speed near synchronous speed is the only requirement. Over-speed protection is needed to shut down the set on loss of load or failure of normal regulation; over-voltage protection is provided to guard against the self-excitation effects already described. Low-voltage protection is necessary to ensure that the machine will shut down if the network supply fails, otherwise there would be a risk of the machine being switched in while at rest.

The relative simplicity of the induction generator imposes a few difficulties in commissioning and in operation, compared with a synchronous machine. Drying out windings is one such difficulty. Synchronous machines are usually dried out on short-circuit at low voltage. Since induction machines have no exciter, this cannot be done. For medium voltage or 3·3 kV windings, electric heaters placed in the stator frame for some time before commissioning have been used. For 11 kV windings, such indirect methods are not satisfactory and circulation of a current of about full-load magnitude from a motor-generator set has been resorted to.

Phasing out of the machine is not possible in the normal way, because no voltage exists on the windings until *after* connection to the network. Three ways out of this difficulty are described.

Starting may be a problem with some Kaplan turbines, because the guide-vane opening required to overcome initial bearing friction may be greater than that for normal operation at no-load. There may be little time to reclose the guide vanes after starting, before the speed is reached which will operate the over-speed trip. This can be managed conveniently with local manual control, but presents some difficulty with remote automatic control.

Economics

Use of induction generators brings savings arising from omission of governor actuator, automatic voltage regulator and control panels and wiring associated. Staff attendance and operational costs are reduced. Also, low total generation costs are achieved from sets worked by compensation water and by inter-reservoir installations. This follows because investment in additional constructional works can be small. At such plants, cost of electricity is usually between one-half and one-third of that at main stations.

At present there are 29 induction generators installed on the North of Scotland HEB system, or under construction. They range in rating from 30 kW to 5 MW, aggregating 27 MW. The paper describes some of the installations in detail, including the 5 MW Sron Mor installation, which is a combined generating/pumping plant.

DISCUSSION

Prof M. G. Say, who opened the discussion, concentrated on the theoretical aspects of induction generators. He was followed by Mr T. W. Wilcox (Merz and McLellan) who said that the unique feature of the induction generator was its possibility as a synchronous compensator. In that role it saved money and did not cost anything. But it had to be borne in mind that the synchronous machine also had capabilities in the leading current zone, to an extent not always realised. The Kariba machines had been operated at leading rating exceeding the lagging load capabilities, though this introduced some difficulties with automatic voltage regulators. He thought the low generation costs for induction generators advanced by Mr Allan somewhat difficult to accept. In connection with protection against the tendency of the induction generator to run away, Mr Wilcox commented that over-voltage protection was difficult in some ways, because it had to operate extremely quickly to avoid damage to insulation, and there was little margin for inaccuracy in setting.

Mr J. C. Beverley (English Electric) discussed the economic advantages of induction generators. He thought the elimination of the exciter and the a.v.r. saved about 5% of the cost of a synchronous machine, the absence of a governor mechanism on the turbine saved 10% on the cost of a turbine, even though this has to be designed for full runaway speed. The third advantage arose from the second. If there was no governor, there was no need to provide for the flywheel effect arising from the incompressibility of water. The saving from this aspect was about 20%. Mr Beverley said he believed that the Sron Mor 5 MW machine was the highest-rated of its type in the world. He suggested that switching-in of induction generators should not involve much worry about speed.

Mr D. D. Stephen (AEI Heavy Plant Div.) suggested that switching-in from rest should be possible. He thought that for slow-speed generators, synchronous machines would be smaller and lighter and of higher efficiency than induction machines, and if the brushless type were used, there should be no trouble with brushgear.

Mr H. Headland (Kennedy and Donkin) underlined the contribution induction generators made to hydraulic economy by facilitating use of statutory compensation water. He discussed the possibilities of induction generators for higher capacities. Fears about the behaviour of induction generators, expressed in earlier days, had been shown to be unfounded, and there was something to be said for a larger set. Most of the saving came in the cost of the alternator with a low-head machine. He predicted that large induction generators might prove useful for tubular type hydro machines, where space considerations and excitation were of more importance.

Mr H. E. Clapham (Bruce Peebles) described tests on switching-in sets, and warned that where gear drives were involved, it was better to switch-in at speeds above synchronous, to avoid trouble with gear back-lash. He advocated the use of a stroboscope to check speed of set against synchronous speed, as this avoided problems introduced if system frequency had dropped.

Mr E. B. Cocks (Preece, Cardew and Rider) thought the robustness of the induction generator a big attraction for use in hydro schemes. Mr P. Richardson (Parsons) considered the possible extension in size of the induction generator and described direct-switching of bars of unexcited 60 MW steam machines.

Mr W. L. Kidd (S of SEB) said his board was concerned with costs as the largest customer of the Hydro Board. When considering the use of induction generators, account should be taken of any extended running of time-expired steam plant which their application implied. For a hydro scheme of 10% annual load factor, the cost should not exceed £60/kW for it to be an economic proposition. In the next few years, the line charging current problem in Scotland would increase to such an extent that the contribution of induction generators was likely to be of little significance.

Mr N. A. Adcock (English Electric) noted that induction generators were not restricted to water-turbine-driven machines; he mentioned an installation of several small machines belt-driven for oxygen plant expansion engines. Commenting on the insensitivity of current surge on switching-in to speed deviation from synchronous, he related this to the speed/torque characteristic of the induction generator being substantially linear at the speeds concerned. If a set was switched in at standstill, the heavy current surge would be prolonged, which might bring heating difficulties.

Other contributors to the discussion were Messrs P. Richardson, C. E. Stille, K. J. Eales and R. G. Smith.

NOTES ON WIRING

BY MEGOHM

ONCE more the doors have closed on Earls Court and the ASEE Exhibition, and the tired representatives who manned the stands have, I sincerely hope, recovered their voices and their energy. Just in case they feel that their efforts were taken for granted, I take it on myself to say "Thank you," on behalf of the many visitors, to these stalwarts who answered our questions, dismantled and assembled various accessories and regaled us with bottled cheer! I not only enjoy the exhibition from a technical angle, I also enjoy writing about it for it gives me the chance to go beyond my normal boundaries of installation matters into the field of appliances and lighting fittings which do, of course, affect installations but are not normally mentioned in these columns.

With this extra license granted to me I followed the trend of my last notes, which dealt with the problems of drying clothes in flats, etc., by making an exhaustive study of drying cabinets on the stand of Messrs Electrix Ltd, Dagenham, Essex. Their representatives demonstrated their Model T.306 cabinet which, besides drying and/or airing the weekly wash, heats the room and can dry the crockery, too. The loading of this cabinet is 1,250 W and costs £16 9s 9d, including tax. I was impressed by the quality of the product and was even more impressed by the electrically heated, oil-filled towel rail, which is rated at 125 W. This is, in my opinion, an excellent piece of apparatus. Not only does this dry the towels most effectively, it also acts as a heater, and being a cold mortal, I am sure this is an answer to my bath-night shivers.

Consumer's Unit

On, then, to Messrs Crabtree's stand, where the crowds were gathered round the consumer unit fitted with m.c.b's. I have already mentioned this unit and its companions, the surface and flush boards with m.c.b's, and can only repeat my previous remark that I consider these boards, and the unit, to be a real step forward in bringing safer protection into the home. This firm, of course, has now a most impressive coverage of the electrical engineer's requirements, from domestic to industrial situations. Their new flush spur box is excellent and graceful in appearance. With the ingenious knock-outs to allow the flexible of a fixed piece of apparatus to be taken through the plate I feel certain that the contractor will use this spur box extensively. Of course, it is impossible to cover entirely this firm's range, but they have plenty of literature available for all interested.

Messrs M. K. Electric Ltd. displayed new boxes suitable for m.i.c.c. cables to BS and plaster depth with detachable clamps for single or twin entries. I was pleased to see this practical sign of interest by an accessories firm in the adaptation of boxes for m.i.c.c. cables, for it must help the contractor, or stockist, to be able to order everything from one firm. Also on show was a most useful insulated box for use in fitting sockets to existing skirting boards without the need to improvise fixings which may not stand up to use. These boxes are due out in June this year, and I advise contractors to acquaint themselves with these boxes, and by doing so save time and trouble on rewiring jobs. Messrs M. K. have improved their plugs by using terminals with captive washers which, I feel, will be greeted with joy by the electrician. Also, the retaining screw holding the plug together is now captive and also anchored by means of a shakeproof washer.

Lighting

Again I spent more time than I should have done on the stand of the Rowlands Electrical Accessories Ltd, but this is inevitable when such common sense is put into the design and manufacture of special fittings. Some years ago I had my first meeting with this firm's now well-known Reflectorlight fitting and I read and heard of this product's further adventures, not only in corrosive situations in this country, but abroad where sun, wind and even sea spray add to the hazards. This fitting has been the subject of many reports, and a booklet is now available on request called "Reflectorlight History," and anyone who has the problem of corrosive conditions and requires a fitting which will withstand such conditions can find the answer in the booklet. This firm has a lantern for every type of lamp used for floodlighting, including the new 1,000 W FL2 lamp. It also markets a range of fittings suitable for domestic and school situations, and I was particularly pleased to see the precautions taken to point out the dangers of using the new small 100 W lamp in fittings suitable only for 60 W lamps. One other item on this stand caught my eye just as I was leaving. This was a "water-trap" box for mounting on the end of an outside bracket. A simple yet extremely useful box and worth while keeping in mind.

Messrs Simplex displayed their vast range of accessories, switchgear and lighting fittings. Their Star range of switchgear, which first appeared last year, was well in the forefront, and this is as it should be. I have installed quite a number of these switches and have had no adverse criticism at all. An impressive array of flameproof equipment was being eagerly inspected by a group of engineers concerned with oil installations. The cooker control units were also being discussed, and I am glad to note that so many engineers are concerned about the rapidly rising loadings of cookers. The switch incorporated in these cooker control units is, of course, well known as being capable of taking a 45 amp load without troubling itself.

Water Heater Economics

The domestic side of Messrs Simplex bears the trade name of Creda, and some months ago I mentioned in these Notes that I had installed a water heater with which I was more than delighted. This was, of course, the Creda Corvette, and I am now going to claim that this heater has saved me thirty shillings on my quarterly electricity account. My home habits are very set indeed, and I made a point of installing this heater just as it neared

the time for the meter reader to make his appearance. I noted the figure, then laid aside my electric kettle and used the immersion only for heating the water for baths, but I did, of course, use the coal fire, which has a back boiler, at week-ends. By boiling up the amount of water required *only*, I have managed this saving. I have not in any way stinted my comfort or cut down my tea drinking and, therefore, credit my Corvette with saving me money.

Messrs Nettle Accessories Ltd. displayed their range of contemporary lampholders to the latest supplement BS 52. Their extensive range has been often commented on in these columns. Although I dislike adaptors, my opinion of this firm's bedside adaptor is that it represents a very sound job indeed and less prone to cause trouble than others I have seen. The unit has four 5 A 2-pin sockets arranged on the body and can be had for 15 or 13 A sockets, and coloured brown or ivory. The 2-pin plugs for use with this adaptor are neatly styled and the adaptor is fused and shuttered. Used with intelligence I consider this a useful adaptor which goes a long way in overcoming my prejudices against such accessories. This same firm, in co-operation with the well-known firm of "Blaco," have introduced an all-insulated conduit system with the name of "Blacon," complete with all accessories. Of course, Messrs Nettle are widely known for their accessories, and I understand that their representatives were kept busy answering questions from the many overseas visitors who were at the exhibition.

Switchgear

The stand of Messrs Ottermill had a display of trunking, busbar trunking and cubicle switchboards, which must have aroused much interest. I have seen several installations controlled by Ottermill gear and heard much in its favour. The gear is robust, clean and well designed, with ample room for cables and their connection. The handles are front handled with clear "on"/"off" indicators. These boards are, of course, "made to order" and a competent staff is available to assist the engineer in getting the boards to fit restricted spaces which, in spite of pleas, are reluctantly given to house main panels. This firm also manufacturers a miniature busbar trunking which should prove useful to people interested in the layouts of machine shops, etc.

Messrs Wylex are well known in the domestic sphere, and I noted that they have now departed slightly from their all-insulated range to provide an all-metal consumer's unit, which I think might well meet with equal demand as their original product. I noted that the firm's two-way switching arrangement for immersion heaters was still arousing interest, although it has been on show before, and I am still rather surprised that contractors have not made fuller use of this excellent product.

A visit to the MEM stand means a great deal to me because of the opportunity to discuss technical developments with their chief designer. Their display this year featured their excellent switchgear which was in its prototype stages last year. The criticism and comments of the original designs have evidently been taken into consideration in the final design. Any firm which tackles a problem in this manner cannot fail. Their accessories range is also extensive and well up to date in design. Close attention has been given to the possible requirements for control of floor-heating installations, and a varied build-up of components is readily available.

Messrs Mantel Metalworkers Ltd. displayed their rising main system, cable trunking and consumers' units, and whilst these proved very interesting my attention was drawn to their new development. This was an external access meter case for building into the outside wall of a building to enable the meter reader to do his work without having to go into the house. The unit can be arranged to house all equipment which comes under the electricity board's jurisdiction, including time-switches, etc., for control of off-peak loads. I understand that, in certain areas, the board assists financially in the installation of these units because of the economy they bring. I consider this to be a really excellent development.

Messrs Falk Stadelmann Ltd. again had a display of lighting fittings which impressed me. The quality of the glassware, and the design of it, interests me very much. Their contemporary fittings are well designed and within the reach of everybody's pocket. Their accessories created interest, and the "Snapfast" switch has proved my prediction on its first appearance that it would retain its popularity for many years to come. The entry into floor-heating by this firm was not heralded by the usual fanfare of publicity, but behind this quiet introduction was the knowledge that their experts were fully competent to deal with this ever-increasing trend of heating. Much interest was aroused in the various conductors available for floor-heating and also in the "Florawarm Monitor." This is an instrument designed to guard against damage to the cables during the laying of the embedding screed. The instrument is powered by a standard 90 volt battery with a separate 6 volt battery for the operation of the audible and visual alarm. A standard jack socket-outlet is incorporated by which means an extension of the alarm circuit may be provided, and this mutes the alarm mounted within the instrument and transfers it to a remote station. Space prevents me from giving full details here, but I feel that this instrument will be in great demand.

So there it is, the exhibition over for another year, and again I must apologise to the firms whose stands I was unable to visit, and to the manufacturers whose products have not found a place in this necessarily brief review.

Wiring in M.I.C.S.

MINERAL-INSULATED copper-sheathed cable has a wide variety of applications in the electrical industry, and several special techniques have been evolved for dealing with these. A new publication of Pyrotenax Ltd., of Hebburn, Co Durham, will be welcomed by installation engineers because it brings together several of the company's sheets of recommendations for such techniques, as well as comprehensive lists of all types of cables and accessories.

The standard installation and sealing instructions for cables in a straightforward wiring installation are included in the form of the familiar illustrated booklet. Information on heating cables suitable for use in tracing oil feed pipes and the like includes the necessary information on jointing and terminating, and also examples of the necessary calculations. Another leaflet included in this collection deals with floor-warming applications.

Pyrotenax cables have applications in temperature measurement and thermocouple jointing heads are available, together with a range of compensating leads and base-metal thermocouples. There are notes on these, and also on one special application in which Pyrotenax has made a success—concentric-earth conductor installations.

Naval Planning to Reduce Breakdowns

COMPREHENSIVE DOCUMENTATION FOR PREVENTIVE MAINTENANCE

SUCH has been post-war development in the Navy that the scope and size of the electrical equipment and installation in modern fighting ships almost beggars description. In size, it may well make many fair-sized industrial installations seem insignificant by comparison; in terms of utilisation, it must cover virtually the whole field of power and light-current application.

It will be readily appreciated that all this equipment must be maintained at a high state of fitness for service. Breakdown could, in adverse conditions, result in severe limitations on the control of the ship or its fighting ability, with all the hazards that this entails.

Breakdowns, or defects of one kind or another, cannot be wholly avoided and, of course, must be expected in time of war as a result of enemy action. Such contingencies are catered for, as far as possible, by duplication, or even triplication, of certain plant and by arranging for emergency connections to be made to bring temporary supplies to the equipment requiring it.

The risk of breakdown, however, has been substantially reduced by carrying out preventive maintenance of all electrical equipment, in a scheme which was introduced three years ago and is as comprehensive as any to be found in industry. As those who visited the mock "Ship's Electrical Office" included in the Admiralty's display at this year's Electrical Engineers' Exhibition will have realised, there must be few firms who have introduced documentation to the extent adopted in the Navy and use it as efficiently. The exhibition provided a convenient opportunity to study a system whose features deserve detailed attention in industry.

Basis of Scheme

The basis of the scheme is a master record which purpose is to provide a complete index of the ship's electrical equipment which requires regular maintenance. It takes the form of a loose-leaf "Kalamazoo" file with specially printed sheets of different colours which provide facilities for recording occurrences of historical importance in the life of the equipment and contains all the information about the equipment to which reference may be required, except that of routine maintenance which is dealt with in another manner.

To build up the master record, ten basic sheets are used, their format being designed so that any particular sheet may be applied to any particular equipment. In other words the sheets may be suitable for a 6 MW alternator or a radar set. For this reason, specific titles and headings have been reduced to a minimum and made as general as possible. The sheets comprise:

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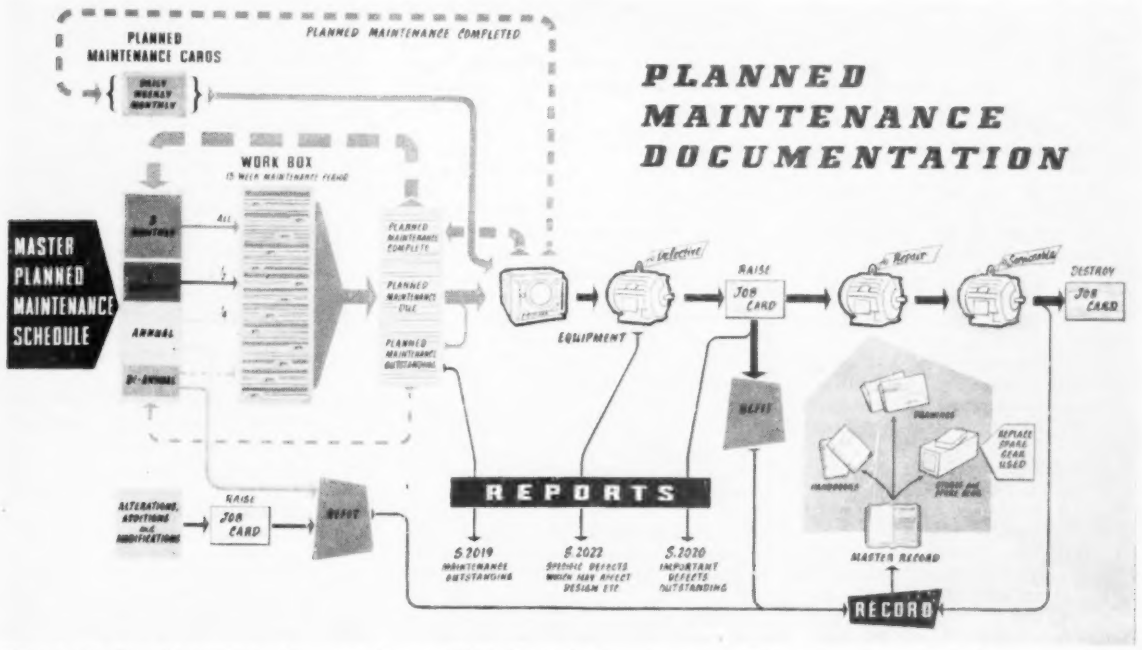

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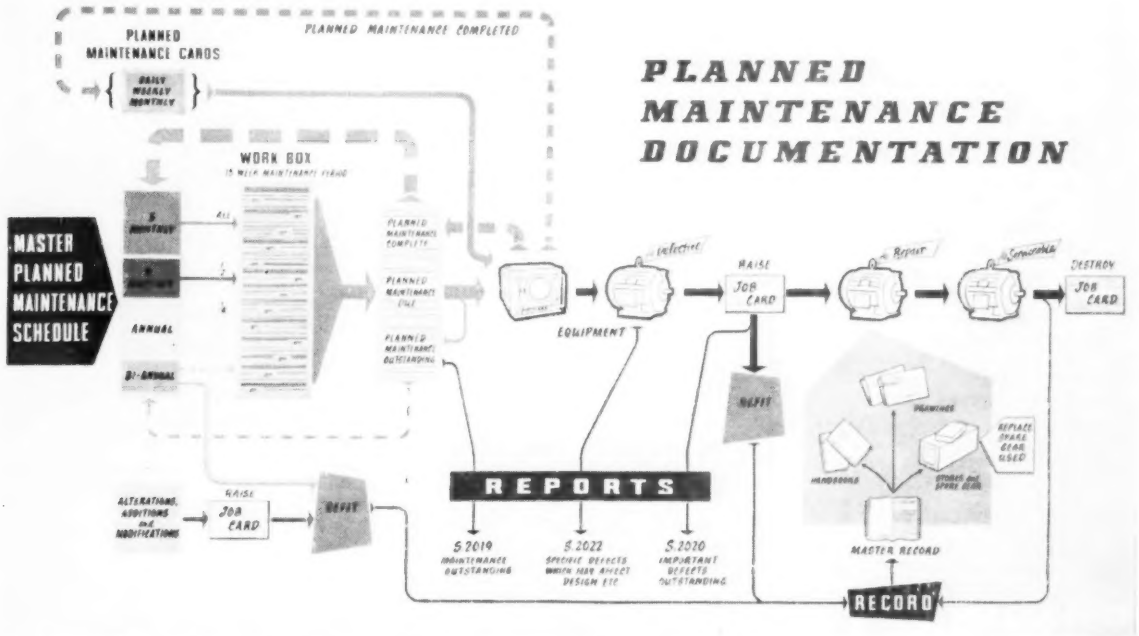


"Flow chart" of naval preventive maintenance scheme. This indicates the general operation of the system; its component documents and their significance are explained in the text

for the particular ship and included in the master record.

Index sheet 1. This provides an index of components of a system or large equipment such as a switchboard.

Index sheet 2. This provides a list of identical equipments to follow a master sheet where the use of record sheet 2 would be unwarranted because the historical details of each item are not of sufficient importance to justify the number of such sheets this would entail.

Index sheet 3. This is normally used to specify the positions of switches in a system to produce the necessary conditions for specific tests.

Index sheet 4. This is used to compile an index to components in a system where index sheet 1 would be inappropriate. Column headings are left blank to permit wide application and the addition of extra columns where required.

Index sheet 5. This provides an index of circuit-breakers and is used where index sheet 2 would be used for other applications.

The master sheet above is coloured pink, record sheets white and index sheets green. Information on a master sheet for, say, a main alternator would include: manufacturer; name-plate, details of performance, supply, design and ratings; type of bearings and dimension of permitted wear; brush grades, size and pressure; type of ventilation. It would also indicate any associated equipment such as exciters, machine heaters, etc., and give reference to any manufacturer's literature on the equipment. There is also reference on the master sheet to relevant parts of three other sources of information: the maintenance schedule handbook; folio of drawings and spare parts list.

Maintenance Handbook

The maintenance schedule handbook, as its name implies, provides a record of the routine maintenance to be carried out on every type of electrical equipment which requires it. The schedule lists every operation which has to be carried out, under its appropriate periodicity. The following example for a main alternator is typical of the thoroughgoing approach adopted throughout:

Daily

Check (a) slip-rings of generator and main exciter commutator for sparking.
(b) bearings and carcases for overheating.
(c) temperature of cooling air as recorded in switchboard log.
(d) that noise and vibration is not excessive.
(e) indicator lamps on switchboard.
(f) that heaters of stationary generators are switched on.
(g) oil level in pedestal bearings (of diesel driven machines).

Monthly

On generator; remove drain plug and check for signs of water.

On main exciter; open, clean off brush gear and all accessory parts. Record the insulation of exciter armature—main rotor circuit from one brush of the exciter.

Three-monthly

On generator.

Check (a) length, freedom and pressure of brushes.
(b) slip-rings for scoring.
(c) operation of heaters and tightness of connections.

Reverse slip-ring connections.

Renew oil in pedestal bearing sumps.

On main exciter, metadyne and auxiliary generators.

Check (a) as above.
(b) condition of commutator.
(c) internal connections and condition of driving belt.
(d) condition and tension of driving belts.

Clean and blow out; carry out insulation tests (with appropriate details given of tester connections for each type of machine).

On automatic voltage regulators.

Inspect and clean; check internally and externally for damage, signs of overheating or chafing of components, wiring or insulation; clean out dust using soft brush and vacuum cleaner.

Six-monthly

On alternator.

Examine cables in vicinity of governor motor and overspeed trip assembly; check insulation from terminal chamber.

On a.v.r.'s.

Insert and set up spare relay panel and amplifier in regulator.

Annually

On alternator.

Clean and blow out; grease all bearings; open Bibby coupling, examine springs for wear and repack with grease of required grade.

On air coolers.

Inspect and renew if necessary all corrosion pieces; remove any sludge present.

On tail-end bearings.

Examine white metal for signs of scoring; check oil seals and that oil distribution is satisfactory; check clearance and bearing wear.

Apart from the foregoing, the routine requires voltage recovery tests to be carried out at 18-monthly intervals. Details are also given of work to be undertaken when refitting every three years and at every 4½ years.

Week-to-week Running

To ensure that the maintenance is carried out regularly, and any defects reported, the actual week-to-week running of the scheme is based on a maintenance record system. This makes use of transparent plastic envelopes housed in drawers in a small filing cabinet; each envelope contains a record card for the equipment, an instruction card and a check card, whose functions will be described later.

A complete drawer contains routine operations for one quarter of 13 weeks, for work which has to be carried out at intervals greater than one month. The envelopes are grouped into time intervals (as shown on the diagram), by means of coloured tape borders, and then further grouped into weeks. These will comprise an assortment of record cards covering quarterly and half-yearly, yearly and two-yearly maintenance jobs which are to be carried out during that week. Daily, weekly and monthly work is separately indexed in a second set of cards.

At the beginning of a week the group of cards for that week are taken from the front of the drawer and issued, together with the shorter-interval cards, by the electrical officer to the senior rating (artificer) responsible for the class of work to which they refer. It is then his responsibility to distribute the work among the ratings under his authority and to supervise its carrying out. At the end of the week the cards are returned to the electrical officer, who replaces them at the rear of the drawer.

Record Cards

Of the three cards in each envelope, the record card carries the title of the equipment and a reference of the maintenance schedule. It is ruled into vertical and horizontal columns. The former indicate the item of work, man-hours taken, date completed and confirming signature; the latter specify the particular item—whether a three-monthly or six-monthly maintenance operation. The reverse side of this card is left blank for departmental notes.

The instruction card simply carries details of the work to be carried out at each time interval. As an example, for self-cooled a.c. motors, maintenance operations are:

Three-monthly 1.

(a) grease bearings.
(b) clean ventilation grilles, if fitted.
(c) remove drain plug, clear entry and drain any moisture.
(d) examine motor terminal box for signs of internal condensation.
(e) inspect (if possible without disconnecting) cables in conduit for signs of chafing or deterioration.
(f) carry out insulation test on motor and associated control equipment; test continuity of bonding and earth lead on machines so fitted.
(g) where applicable, carry out test of heater circuits (internal and external, including lubricating oil heaters); check connections and correct operation.
(h) examine all cables, conduits and bonding connections for signs of deterioration.

Three-monthly 2.

Check operation of emergency stop pushes, float switches, remote controls, safety cut-out and other control or protective devices.

The third card has a checking function. When the envelopes are issued, it is removed from each and retained in another drawer during the week of plant being maintained. It is returned to the envelope at the end of the week.

ELECTRIC MOTORS IN TANDEM

CONSIDERATIONS IN BALANCING TORQUE AND SPEED

by J. L. Watts, A.M.I.E.E.

IT sometimes happens that a motor driving a line shaft becomes overloaded due either to additional machines being driven from the shaft or to the load on one machine being increased, as might occur if it is driven at increased speed or with increased rate of feed. The usual remedy, of course, is to split the load or fit a larger motor.

However, it is often possible to overcome the difficulty by using an additional motor to drive the line shaft. In some cases it is required to drive a machine, possibly for a short period as may be required to measure the power required, where a sufficiently large motor is not to hand. It may be that there are available two smaller machines which will do the job.

Matching of Speeds

There are no particular difficulties in using two motors to drive the same shaft. If the rated speeds of the two motors differ, this can be accommodated by using pulleys of suitable ratio. If the load on the shaft is fairly constant it is practicable to drive this with any two motors of sufficient total horse-power. If the total shaft load is equal to the total horse-power of the two motors, and the pulley ratios are such that each motor then runs at its rated speed, the motors will then share the load in proportion to their horse-power ratings, even if both are not the same size.

However, if the load on the shaft varies, the motors will only share a reduced load in proportion to their respective horse-power ratings if each have the same percentage slip on full load. For instance if machines of 10 h.p. and 5 h.p., respectively, driving a common shaft both run at 95% of their respective synchronous speeds on full load, each will be loaded to approximately half their full-load values if the total load on the shaft falls to 7½ h.p.

Differing Slip Speeds

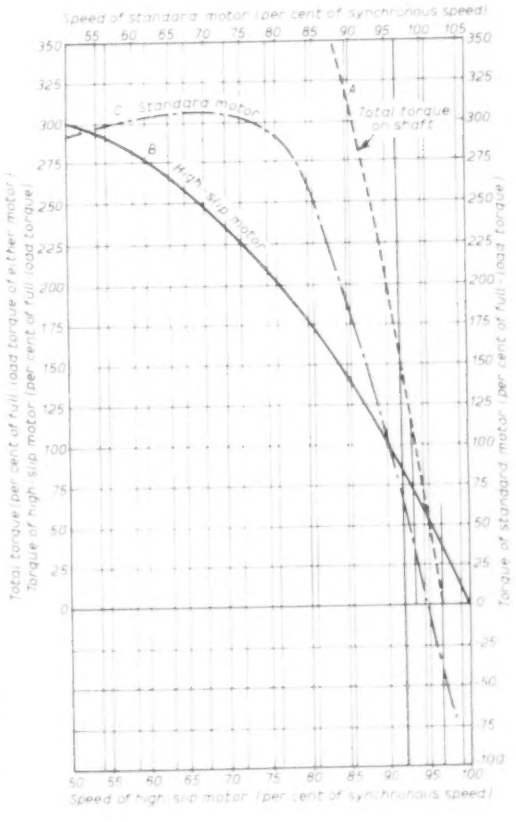
This will not be the case if the full-load slip of the two motors differs appreciably, as can be shown by considering an extreme case in which a high-slip motor, having 10% slip on full load, as in curve B, on the accompanying diagram, is used with a standard squirrel-cage motor having 5% slip on full load, as in curve C. The pulley ratios should be such that, when fully loaded, the high-slip motor runs at 90% of its synchronous speed, whilst the standard motor runs at 95% of its synchronous speed. As shown in the diagram, both motors will then be fully loaded when the total load on the shaft requires twice the horse-power of either motor, assuming two motors of the same horse-power are used.

However, if the total load on the shaft then falls to 75% of the maximum value, the speed of the high-slip motor will rise to about 92% of its synchronous speed. Assuming there is no belt slip, the standard motor will then be running at about 97% of its synchronous speed. Under these conditions the high-slip motor will have 85% of its full load, whilst the standard motor will have 65% of its full load. On 50% of total load, the high-slip motor will carry 35% of the total load, with only 15% of the total load being carried by the standard motor.

If the total load falls to about 28% of the full shaft load, the shaft will be driven solely by the high-slip motor running at about 94% of its synchronous speed. This machine will also be driving the standard motor at its synchronous speed. Under these conditions the mechanical power applied to the standard machine will merely be that necessary to overcome its friction and windage losses, whilst the power drawn from the supply will be sufficient merely to compensate for the core losses and the small I^2R losses in its stator windings. It will be seen, therefore, that the standard motor will be developing no torque.

If the total load falls still further, the high-slip motor will drive the shaft and also drive the standard motor at more than its synchronous speed. Under these conditions the latter motor will act as an induction generator and will return power to the supply mains, developing a negative or braking torque in doing so. With no load on the shaft, the high-slip motor would run at about 96% of its synchronous speed and, neglecting losses in the shaft and belts, the whole of its output would be absorbed in driving the induction generator at about 102% of its synchronous speed.

Normally there is no difficulty in starting each of any two parallel-drive motors in turn, provided the shaft is not loaded to such a degree that it cannot be started by either motor. The first motor to be started will then drive the shaft and the other motor, the latter merely requiring sufficient power to overcome its frictional and windage losses. When the stator windings of the second motor are energised they will draw from the mains sufficient power for the motor to develop the required torque, as determined by the shaft load and speed.


Speed of standard motor (per cent of synchronous speed)
55 60 65 70 75 80 85 90 95 100 105
C Standard motor
B High slip motor
A Total torque on shaft
Total torque (per cent of full-load torque)
Torque of high slip motor (per cent of full-load torque)
Torque of standard motor (per cent of full-load torque)
Speed of high slip motor (per cent of synchronous speed)
50 55 60 65 70 75 80 85 90 95 100

Torque/speed curves of standard and high-slip motors, showing how load will be shared between the two machines at different speeds when operated in tandem to drive one load

Electrical Facilities for Engine Testing

DYNAMOMETER SYSTEMS FOR TORQUE AND SPEED MEASUREMENTS

THE motor-car industry is generally regarded as one of the leaders in applying technological developments, notably, of course, to the large-scale production by which it is characterised. This reputation, however, is to be found in spheres other than production; a good example was provided recently at the Luton works of Vauxhall Motors Ltd., in the form of a new dynamometer installation for engine testing.

This installation forms part of the engineering services provided by Vauxhall for their production and, at a visit we were privileged to make, it was possible to see other facilities which have recently been introduced for the testing of vehicle components and assemblies. From the electrical viewpoint, however, the dynamometer installation is pre-eminent. Its interest is enhanced, for the British engineer, by the use of American machines for much of this new facility.

There are three new dynamometers so far installed, to be joined by a fourth in the near future; they are housed in a new engine-development building which is the first stage in a programme expanding the department concerned with vehicle design and improvement. Apart from nine dynamometers which have been in service in the main engineering building since 1937, later stages of the programme will bring the total of test-room dynamometer machines to 16 (of various types to cover petrol and diesel engine need) and will also include a vehicle dynamometer for measurements on engines installed in vehicles.

Plant Utilisation

The dynamometers are employed to carry out measurements of engine characteristics—power output, torque—under controlled conditions, to enable a given design to be examined thoroughly. Their use is an essential supplement to road tests. The chief value of the new machines is that they afford greater accuracy of measurement, under closer control of operating conditions.

The dynamometer building itself is a functional design in a combination of reinforced concrete and structural steel. It is in two main sections: one of two storeys housing the four dynamometer rooms and the other of three storeys containing a carburation and fuel injection test room, and offices. Extensions may be added on the further side of the entrance section. A separate building is used for fuel storage and pumping.

The dynamometer rooms are arranged in pairs on opposite sides of a central corridor. Between each of the two rooms making a pair is situated a joint equipment room, housing all auxiliary services other than the main electrical and ventilation plant. Above the dynamometer area and, extending at the same level over the entrance section, is a services plenum, which forms a second floor and houses cabling, ventilation, water, compressed air and heating services, to facilitate access for maintenance and keep the dynamometer rooms as clear as possible. Above the services plenum, over the entrance area only, is a third storey electrical-plant room housing motor-generator sets and control gear cubicle for the dynamometers and the main switchgear.

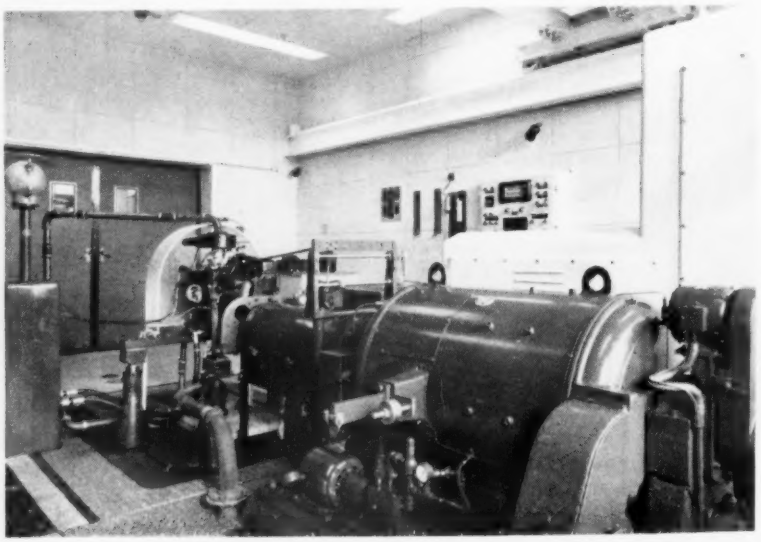
The dynamometer rooms are each 24 ft long by 16 ft wide by 11 ft high. Walls and ceilings are provided with a soundproof lining, consisting of perforated trays of 16 s.w.g. steel containing a 3 in. thick rock-wool blanket. All services within the test rooms are concealed behind the lining. Lighting is of multi-lamp fluorescent units, recessed into the ceiling.

Equipment Details

The three dynamometers so far installed are all of American General Electric manufacture, and were supplied complete with control gear, motor-generator sets and amplidynes. They cater for the testing of engines of up to 150 h.p. output, and have a maximum speed of 6,000 r.p.m. The fourth dynamometer to be installed later this year is being supplied by Heenan and Froude; it has a maximum capacity of 200 h.p. and speed of 5,000 r.p.m.

The GE dynamometers are 250 V. d.c. machines, with Class B insulation. They are force-ventilated, to permit operation at maximum armature current throughout the speed range. The stator frame, of rolled steel with bolted-on end-covers, is cradled in trunnion bearings which are of special design to ensure high accuracy and low friction. The end cover of the frame carries a trunnion sleeve which is

Control desk of dynamometer engine test set at Vauxhall Motors new development building. The large dial in rear is torque indicator; controls in foreground relate to electrical equipment



View of dynamometer room showing General Electric's 150 h.p. reversing dynamometer in foreground with engine under test in rear

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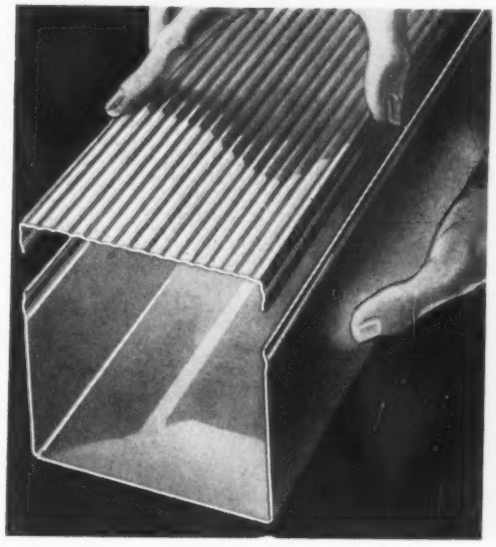

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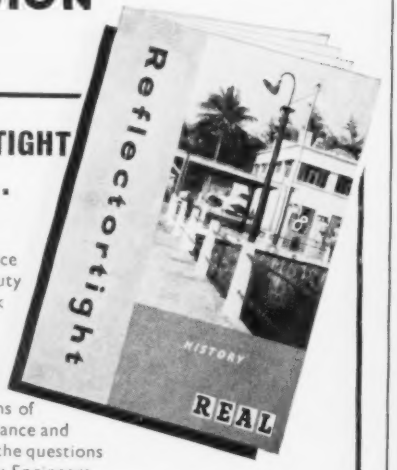

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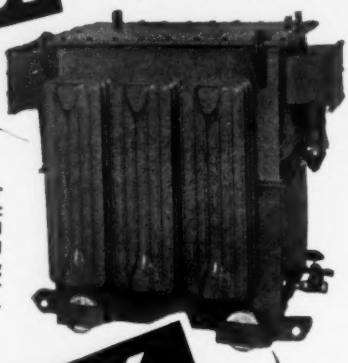

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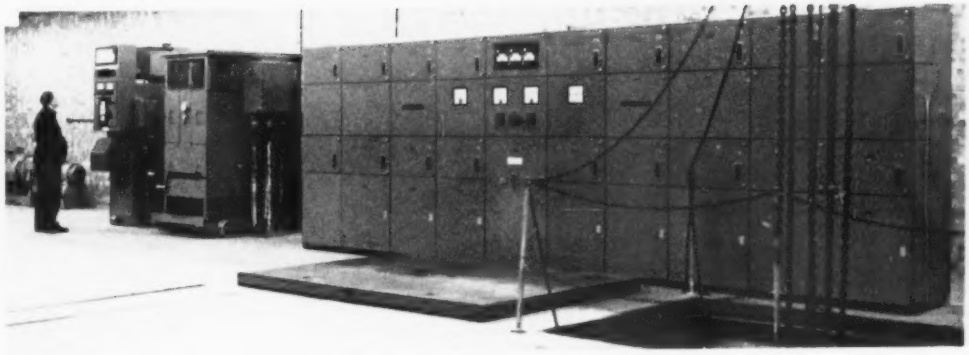


Main switchgear for Vauxhall's new engine development building. Medium-voltage cubicle board is seen on right, with Class C transformer and 6·6 kV circuit-breaker in rear. Note also lifting tackle over aperture in floor through which equipment is brought up into the motor room

supported in the bearing pedestal and through which passes the rotor shaft. A film of oil is continuously maintained between the sleeve and the fixed surfaces in the bearing housing which so reduces friction that the dynamometer frame may be rotated merely by placing a match on the torque arm. Oil is passed into each side of the bearing through restricted orifices, small reservoirs of oil being maintained at the entry points, with pressure sensing and controlling pads connected to each. When the trunnion bearing is running true, the pressures in the reservoirs are identical. Lateral movement increases the pressure in one and reduces it in the other; the pads operate to restore the balance by returning the trunnion to its original position of alignment.

Torque developed in the dynamometer is transmitted over a direct-drive system, the torque arm operating at a radius of 18·007 in. The value of torque is indicated on a large instrument mounted in a vertical section of the control panel, to the left of the operator. The operator actually sits at a control desk, on which the dynamometer electrical controls—armature current, excitation, speed, torque and load—are grouped immediately facing him, with the engine controls immediately to the right. At the back of the panel are grouped indicators for speed, elapsed time, inlet and outlet engine coolant temperatures, engine oil-pressure gauge and oil-temperature indicator. The left-hand vertical section also contains temperature controllers and 12 point thermocouple temperature indicators.

General Operation

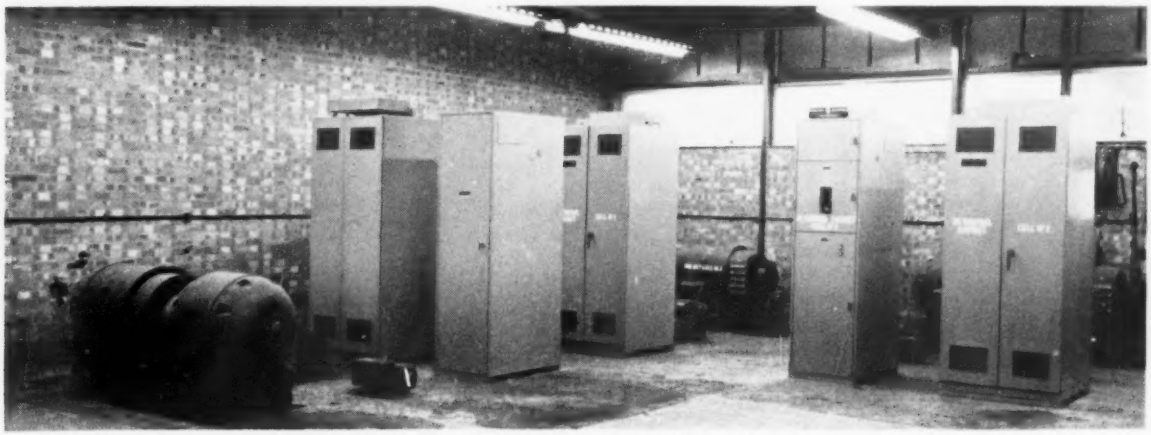
The dynamometer armature is connected on the Ward-Leonard system with the armature of a d.c. machine forming part of a motor-generator set, the motor being of the synchronous induction type. The excitation windings of both dynamometer and generator are supplied from amplidynes, which are arranged to control the speed of the dynamometer and, for certain applications, the torque/speed relationship. The amplidynes are fed from electronic equipment giving speed regulation of 0·5% of the particular value in the range from the maximum speed down to the base speed of 2,500 r.p.m. At values below base speed, the system maintains the dynamometer speed to within 0·5% of the base speed.

The control system permits the dynamometer to be used in either power-absorbing or power-delivering conditions without resetting the scale equipment. In the former case, the dynamometer is, of course, generating and power is delivered into the supply system; in the latter case, the dynamometer is motoring, drawing power from the supply system. Both conditions are required, since the tests include measurement of friction and other torques presented by the engine when it is being driven.

Electrical Plant

As mentioned earlier, the motor-generator sets and their associated equipment are installed on the third floor electrical plant room. Also installed here is the m.v. switchboard for the building, this being English Electric cubicle gear of the "Superform" type, together with supply transformer and English Electric h.v. circuit-breaker. The main supply is at 6·6 kV and in view of the fire risk that an oil-immersed transformer would present mounted on this floor, the transformer is a Brentford Transformer Class C insulated unit, of 750 kVA rating. An overhead travelling bogie has been provided for installation purposes on the floor itself, whilst lifting tackle has been mounted on the roof of the building for raising equipment from ground-floor level through openings in the floor and in the plenum below, communicating with the entrance hall.

A separate test room is also provided for testing carburettors and diesel oil injection systems. These are carried out in separate parts of a single room and, in view of the fire risk presented by the use of petrol in the carburettor section, all lighting fittings and electrical equipment there are of flameproof construction. The diesel fuel room presents a less severe problem and here, vapour-proof fittings are employed. The room is forced ventilated, this system being separate from the main ventilation for the dynamometer rooms.



Motor-generator sets for the dynamometer equipment together with control-gear cubicles

BUSBARS FOR FACTORY POWER

BUSBAR trunking used directly for factory distribution is still a comparative novelty in contrast to the more generally used cabling, although the parallel-bay construction of many factories is ideally suited to its use. A recent example of busbar utilisation in this form comes from the new factory of Cincinnati Milling Machines Ltd. at Tamworth, where the General Electric Co. has recently completed the supply of all major electrical equipment.

The factory has four bays of production space, each 260 ft long by 30 ft wide. The roof is of the portal, "north-light" type, with heights above floor level of 16 ft to the eaves and 27 ft 6 in. to the ridges. The four bays are served by two runs of 500 amp, t.p.n. busbar trunking, from which 100 amp and 200 amp transverse runs are connected through plug-in tapping boxes to supply the machine drives.

At the supply end, the down-shop busbars terminate in a transverse run of 1,600 amp, t.p.n. busbar trunking which is coupled directly to the secondary of the supply transformer through a 440 V, gang-operated off-load isolator unit of 25 MVA through-fault capacity. The transformer is a natural oil-cooled unit, of 1,000 kVA rating, transforming from 11 kV to 433 V. Its h.v. side is supplied from a 250 MVA rupturing capacity oil circuit-breaker, forming the tee-off unit in a non-extensible 11 kV ring main switchboard whose wing units are oil-immersed fuse switches.

Apart from the individual machine tappings, the 500 amp down-shot busbar also supply a motor control centre which controls feed water pumps, circulating pumps, heaters and other auxiliaries of the high-pressure hot water boiler and heating system. This control centre can be serviced entirely from the front, thus permitting its being mounted flush against on a platform in the main boiler house. Its design allows for additions to be made to the boiler house plant if required. The boiler house installation also includes distribution gear made up on site from standard components in the GEC's range of switch-fuse gear and distribution boards. The same construction has also been employed for distribution gear supplying motors and heater controls for operating and protecting storage water heaters and circulating pumps in the calorifier room.

The 1,600 amp trunking also supplies panels for the control of heating and lighting. These, comprising vertical-lift contactors and other components, are mounted on the trunking with standard adaptors.

Lighting in the main production area is provided by twin 8 ft, 125 W Osram fluorescent tubes in trough reflectors. These are mounted end-to-end in pairs on the roof across the bays with the wiring concealed behind the roof lining. The reflector pairs are mounted at approximately 10 ft centres, to give a shadow-free, average service illumination of the order of 38 lm/sq ft. Such illumination enables precision machine work to be carried out without any supplementary local lighting.

The main administration office is lit by continuous lines of fluorescent tubes in diffuser fittings mounted directly on the ceiling. Fluorescent lighting is also used in the small drawing office. Here, the roof construction is similar to that in the main production area and the twin 8 ft trough reflectors are mounted directly on the sloping roof.

In the canteen section, a Lumenated Ceiling is provided above the servery, equipped with 5 ft 80 W tubes in batten fittings. General canteen lighting is provided by single tube 8 ft 125 W lamps in trough reflectors mounted on the sloping roof. Particular care has been taken in the kitchen to ensure that all working surfaces are well lit. This has been achieved by a rectangle of continuous lighting trunking with diffuser fittings end to end, mounted at a height of 9 ft 6 in.

M.A. Rectifier for Reversing-mill Drive

NEITHER the wide use of Ward-Leonard systems nor the growing popularity of semiconductor rectifiers can remove the value of mercury-arc rectification for certain applications, particularly where large-power requirements are to be met. Such a case is provided at the Stockbridge Works of Samuel Fox and Co., where Associated Electrical Industries have recently commissioned a mercury-arc rectifier/inverter equipment to be used, in the first application of this kind, for supplying a 4,000 h.p. reversing billet mill drive.

The equipment comprises ten pumpless steel-tank rectifier/inverter units, of the six-anode type, to give a combined r.m.s. rating of 3,200 kW at an output voltage ranging from zero to 900 V. The rectifier cubicles are sited, together with the associated grid-control equipment, in a row on a gallery in the motor room. Anode reactors for each rectifier tank are mounted in frames above and integral with the rectifier cubicles. All tanks are provided with thermostatic temperature control.

Supply for the rectifiers is from a twelve-phase, 66 kV rectifier transformer housed in a separate substation. On the output side, the direct-current circuit-breakers are mounted immediately below the rectifiers on the floor of the motor room, together with fast-acting armature reversing switch. A laminated-yoke exciter supplies the motor field. Control gear, housed in cubicles, comprises all necessary static amplifiers, transistorised sequence control systems, supervisory instrumentation and alarm equipment.

A closed-loop system of speed control is incorporated, with overriding limitation of current, voltage and acceleration. On both a.c. and d.c. sides, appropriate protection is provided against failure through over-current and back-fires.

The AEI 3,200 kW mercury-arc rectifier/inverter installation in the motor-room of the reversing billet mill at Stocksbridge, with d.c. circuit-breakers below

High-frequency valves for industry

SPECIALISED TECHNIQUES FOR OLD OSRAM LAMPWORKS

UTILISATION of electrical energy at frequencies normally associated with radio transmission form a field of industrial application which is so growing in popularity as to make a visit last week to the MO Valve Co.'s works at Hammersmith of special interest. The premises, moreover, are of historic interest, being the original Osram Robertson lamp works, although their connection with lamps was finally severed at the end of last year when the remaining lamp production was transferred to other GEC factories. The building is now devoted solely to valves, which, since the firm became a wholly owned subsidiary of GEC a few years ago, are exclusively specialised r.f. types for non-entertainment purposes.

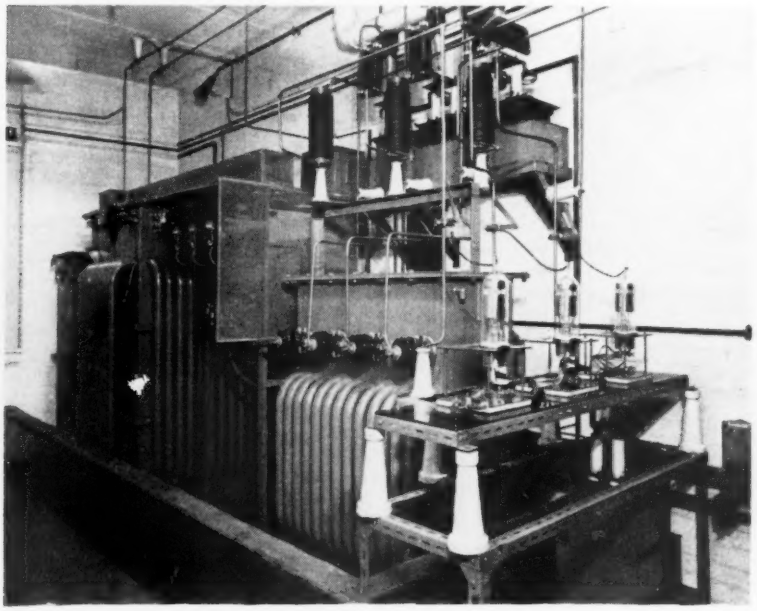
Although most of their output finds its way into telecommunications or radar equipment, the industrial application side is growing. From the valve utilisation aspect, there is no clearly drawn line distinguishing these two fields of application and what may be regarded as standard high-power radio transmitter valves are generally suited for industrial use. Induction heating requires frequencies up to about 1 Mc/s, at powers ranging from about 50 kW to 1 or 2 MW, which is well within the capabilities of radio transmitting valves. For dielectric heating, on the other hand (which is restricted mainly to plastic sheet sealing), although the frequency may be from 20 to 40 Mc/s, powers are measured in no more than kilowatts, although glue-setting applications in the furniture and allied industries may call for as much as 20 kW. The firm includes an application development section at Hammersmith providing a user advisory service for specific applications.

Manufacturing techniques for high-frequency valves, and for ultra-high-frequency devices such as magnetrons, klystrons, travelling-waves tubes and the latest development, backward-wave oscillators, call for scrupulously clean conditions and fine working tolerances.

To meet the former requirement, much of the assembly work is carried out in partitioned-off areas served with filtered air with operatives appropriately dressed to avoid introducing contaminants.

Particularly interesting, however, are the techniques adopted to obtain close tolerances. To give an idea of the tolerances involved, certain high-quality valves having high gain and low noise characteristics at frequencies up to about 1,000 Mc/s are so designed that the grid-to-cathode spacing is no more than 20μ, with a tolerance to within 5μ, to which tolerance the thickness of the cathode emissive coating is adjusted. The grid is a small rectangular molybdenum frame carrying 10μ diameter wire spaced at 506/in. The spacing is determined by winding the wire on a squirrel-cage mandrel comprising 8 rods mounted between end discs. The rods are threaded at 506 thread/in. using a die made from a master cut by the NPL. The spacings of grid to cathode and grid to anode are finally adjusted by measuring the capacitances on each.

Glass is processed with almost equal accuracy. The envelope of a travelling wave tube, for example, comprises a short length of tube about 1 in. diameter joined to another tube of half that diameter or less and from 2 ft to 3 ft long. The diameters have to be accurate to within about 0·0001 in. and the over-all straightness accurate to about 0·0004 in. It is made by a vacuum forming process at some 900° to 1,000°C, using a steel mandrel machined to allow for the expansion of itself and the glass at these temperatures.



The 200 kVA three-phase half-wave set used by MOV for testing xenon rectifiers; the heading illustration shows final adjustments being made to a magnetron

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The factory has four bays of production space, each 260 ft long by 30 ft wide. The roof is of the portal, "north-light" type, with heights above floor level of 16 ft to the eaves and 27 ft 6 in. to the ridges. The four bays are served by two runs of 500 amp, t.p.n. busbar trunking, from which 100 amp and 200 amp transverse runs are connected through plug-in tapping boxes to supply the machine drives.

At the supply end, the down-shop busbars terminate in a transverse run of 1,600 amp, t.p.n. busbar trunking which is coupled directly to the secondary of the supply transformer through a 440 V, gang-operated off-load isolator unit of 25 MVA through-fault capacity. The transformer is a natural oil-cooled unit, of 1,000 kVA rating, transforming from 11 kV to 433 V. Its h.v. side is supplied from a 250 MVA rupturing capacity oil circuit-breaker, forming the tee-off unit in a non-extensible 11 kV ring main switchboard whose wing units are oil-immersed fuse switches.

Apart from the individual machine tappings, the 500 amp down-shot busbar also supply a motor control centre which controls feed water pumps, circulating pumps, heaters and other auxiliaries of the high-pressure hot water boiler and heating system. This control centre can be serviced entirely from the front, thus permitting its being mounted flush against on a platform in the main boiler house. Its design allows for additions to be made to the boiler house plant if required. The boiler house installation also includes distribution gear made up on site from standard components in the GEC's range of switch-fuse gear and distribution boards. The same construction has also been employed for distribution gear supplying motors and heater controls for operating and protecting storage water heaters and circulating pumps in the calorifier room.

The 1,600 amp trunking also supplies panels for the control of heating and lighting. These, comprising vertical-lift contactors and other components, are mounted on the trunking with standard adaptors.

Lighting in the main production area is provided by twin 8 ft, 125 W Osram fluorescent tubes in trough reflectors. These are mounted end-to-end in pairs on the roof across the bays with the wiring concealed behind the roof lining. The reflector pairs are mounted at approximately 10 ft centres, to give a shadow-free, average service illumination of the order of 38 lm/sq ft. Such illumination enables precision machine work to be carried out without any supplementary local lighting.

The main administration office is lit by continuous lines of fluorescent tubes in diffuser fittings mounted directly on the ceiling. Fluorescent lighting is also used in the small drawing office. Here, the roof construction is similar to that in the main production area and the twin 8 ft trough reflectors are mounted directly on the sloping roof.

In the canteen section, a Lumenated Ceiling is provided above the servery, equipped with 5 ft 80 W tubes in batten fittings. General canteen lighting is provided by single tube 8 ft 125 W lamps in trough reflectors mounted on the sloping roof. Particular care has been taken in the kitchen to ensure that all working surfaces are well lit. This has been achieved by a rectangle of continuous lighting trunking with diffuser fittings end to end, mounted at a height of 9 ft 6 in.

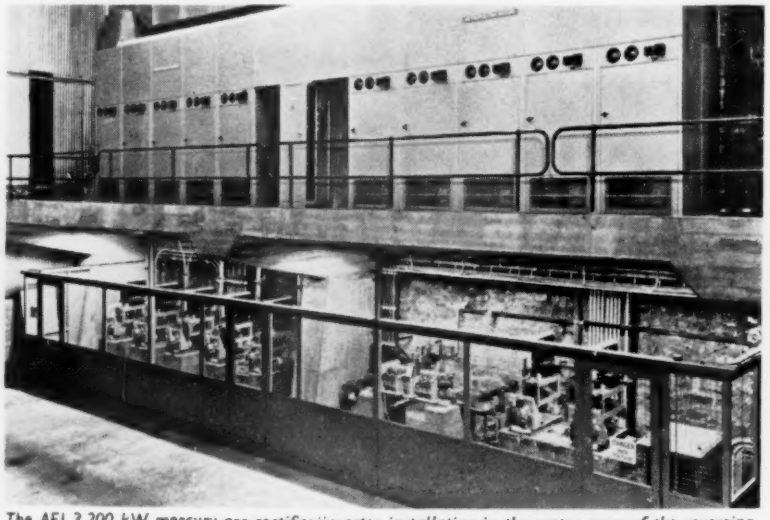
M.A. Rectifier for Reversing-mill Drive

NEITHER the wide use of Ward-Leonard systems nor the growing popularity of semiconductor rectifiers can remove the value of mercury-arc rectification for certain applications, particularly where large-power requirements are to be met. Such a case is provided at the Stockbridge Works of Samuel Fox and Co., where Associated Electrical Industries have recently commissioned a mercury-arc rectifier/inverter equipment to be used, in the first application of this kind, for supplying a 4,000 h.p. reversing billet mill drive.

The equipment comprises ten pumpless steel-tank rectifier/inverter units, of the six-anode type, to give a combined r.m.s. rating of 3,200 kW at an output voltage ranging from zero to 900 V. The rectifier cubicles are sited, together with the asociated grid-control equipment, in a row on a gallery in the motor room. Anode reactors for each rectifier tank are mounted in frames above and integral with the rectifier cubicles. All tanks are provided with thermostatic temperature control.

Supply for the rectifiers is from a twelve-phase, 66 kV rectifier transformer housed in a separate substation. On the output side, the direct-current circuit-breakers are mounted immediately below the rectifiers on the floor of the motor room, together with fast-acting armature reversing switch. A laminated-yoke exciter supplies the motor field. Control gear, housed in cubicles, comprises all necessary static amplifiers, transistorised sequence control systems, supervisory instrumentation and alarm equipment.

A closed-loop system of speed control is incorporated, with overriding limitation of current, voltage and acceleration. On both a.c. and d.c. sides, appropriate protection is provided against failure through over-current and back-fires.



The AEI 3,200 kW mercury-arc rectifier/inverter installation in the motor-room of the reversing billet mill at Stocksbridge, with d.c. circuit-breakers below

High-frequency valves for industry

SPECIALISED TECHNIQUES FOR OLD OSRAM LAMPWORKS

UTILISATION of electrical energy at frequencies normally associated with radio transmission form a field of industrial application which is so growing in popularity as to make a visit last week to the MO Valve Co.'s works at Hammersmith of special interest. The premises, moreover, are of historic interest, being the original Osram Robertson lamp works, although their connection with lamps was finally severed at the end of last year when the remaining lamp production was transferred to other GEC factories. The building is now devoted solely to valves, which, since the firm became a wholly owned subsidiary of GEC a few years ago, are exclusively specialised r.f. types for non-entertainment purposes.

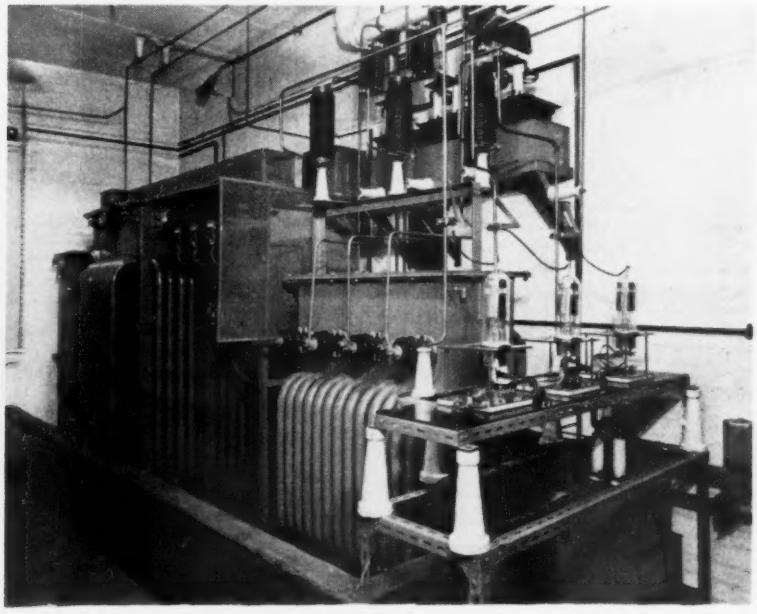
Although most of their output finds its way into telecommunications or radar equipment, the industrial application side is growing. From the valve utilisation aspect, there is no clearly drawn line distinguishing these two fields of application and what may be regarded as standard high-power radio transmitter valves are generally suited for industrial use. Induction heating requires frequencies up to about 1 Mc/s, at powers ranging from about 50 kW to 1 or 2 MW, which is well within the capabilities of radio transmitting valves. For dielectric heating, on the other hand (which is restricted mainly to plastic sheet sealing), although the frequency may be from 20 to 40 Mc/s, powers are measured in no more than kilowatts, although glue-setting applications in the furniture and allied industries may call for as much as 20 kW. The firm includes an application development section at Hammersmith providing a user advisory service for specific applications.

Manufacturing techniques for high-frequency valves, and for ultra-high-frequency devices such as magnetrons, klystrons, travelling-waves tubes and the latest development, backward-wave oscillators, call for scrupulously clean conditions and fine working tolerances.

To meet the former requirement, much of the assembly work is carried out in partitioned-off areas served with filtered air with operatives appropriately dressed to avoid introducing contaminants.

Particularly interesting, however, are the techniques adopted to obtain close tolerances. To give an idea of the tolerances involved, certain high-quality valves having high gain and low noise characteristics at frequencies up to about 1,000 Mc/s are so designed that the grid-to-cathode spacing is no more than 20μ, with a tolerance to within 5μ, to which tolerance the thickness of the cathode emissive coating is adjusted. The grid is a small rectangular molybdenum frame carrying 10μ diameter wire spaced at 506/in. The spacing is determined by winding the wire on a squirrel-cage mandrel comprising 8 rods mounted between end discs. The rods are threaded at 506 thread/in. using a die made from a master cut by the NPL. The spacings of grid to cathode and grid to anode are finally adjusted by measuring the capacitances on each.

Glass is processed with almost equal accuracy. The envelope of a travelling wave tube, for example, comprises a short length of tube about 1 in. diameter joined to another tube of half that diameter or less and from 2 ft to 3 ft long. The diameters have to be accurate to within about 0·0001 in. and the over-all straightness accurate to about 0·0004 in. It is made by a vacuum forming process at some 900° to 1,000°C, using a steel mandrel machined to allow for the expansion of itself and the glass at these temperatures.



The 200 kVA three-phase half-wave set used by MOV for testing xenon rectifiers; the heading illustration shows final adjustments being made to a magnetron

OVERSEAS NEWS

from our correspondents abroad

CANADA

Thermal Plans

Another thermal power project is under consideration in British Columbia. A newly formed company, Imperial Metals and Power Ltd., which has acquired several coal deposits—one of them containing a minimum of 50 million ton—around the Princeton-Merritt-Kamloops area, is proposing to utilise the fuel in generating power to be supplied to the many copper-iron mines being developed in the Highland Valley area. A principal of Imperial Metals and Power, Mr N. H. McDiarmid, is also a principal of Craigmont Mines Ltd., one of the companies nearing production in the Highland Valley. British Columbia copper mines now send their ore or concentrate to a smelter in Washington State, except for one mine on Vancouver Island that ships concentrate to Japan.

Start on Hamilton Falls

Twin Falls Power Corpn. has been formed to manage a new hydro-electric development near Hamilton Falls, Labrador, on which construction work has just started. The new concern is a subsidiary of Hamilton Falls Power Corpn. Ltd., which is in turn a subsidiary of British Newfoundland Corpn. Ltd. The power plant is to be built at Twin Falls on the Unknown River and will have an initial capacity of 120,000 h.p. Completion date, including 230 kV transmission lines, is scheduled for June, 1962. The Iron Ore Co. of Canada and the Wabush Iron Co. have agreed to purchase the power for use in new iron mines opening up in the Wabush Lake area, some 110 miles from the power site.

Shawinigan Plans

The Shawinigan Water and Power Co. expects to commence construction of new power-producing facilities next year and, at that time, additional funds will have to be raised from investors, the company's president, J. A. Fuller, stated recently. Capital expenditure outlay this year, Mr Fuller stated, is expected to be only slightly higher than the $17,451,000 spent in 1959, but appropriations will considerably exceed the amount to be spent during the year with the result that actual expenditures in subsequent years will be very considerably higher. For the five years 1960-64, he estimated that Shawinigan's spending may reach $225 million.

Manitoba's Expenditure

The largest capital expenditure programme in the history of Manitoba, recently placed before the Legislature, provides for a total expenditure of $150 million by the Manitoba Hydro-Electric Board during the next five years. Of that sum, the major portion—$120½ million—is for the proposed new power plant at Grand Rapids. Other large projects are $6,271,000 to complete the Selkirk steam power plant; $5,880,000 to complete the northern power development at Kelsey; $2,240,000 for new terminal stations; $8,078,500 for transmission lines from new plants; $1,358,000 for renovations to existing plants and $290,000 for a power line from Kelsey to the Thompson nickel-mining town.

BRAZIL

Supply for Manaus

As part of Brazil's development of the Amazon River area, Companhia de Electricidad de Manaus is to build a 22,500 kW power plant. A contract valued at about $4 million, placed with Westinghouse Electric International Co., covers three 7,500 kW generating units, which will supply power for Manaus, a city with a population of 146,000, located 1,000 miles up the Amazon. The plant is expected to be completed by the end of 1961.

RUSSIA

Gas-fired Station

It is planned to begin construction next year of a large gas-fuelled power station on the Upper Volga, some 70 miles from Moscow. It will take two years to erect and will be named Konakovskaya, after a nearby town. The station will be fuelled by natural gas from a circuit pipeline now laid around Moscow, which will be connected to the rich deposits of the North Caucasus and the Ukraine. It is estimated that the station will use more natural gas than is now consumed by Moscow and Moscow region taken together. Built almost completely of prefabricated structural elements assembled on the spot, the station is expected to produce electricity at a cost 50%-60% lower than at other Soviet thermal stations. The project provides for the use of electronic devices and programme-operated units which automatically select the best mode of operation for steam boilers and turbines. The station will supply power to several areas of the central and north-western part of the USSR in Europe, including Moscow and Leningrad, and will make it possible, in particular, to complete the electrification of the 400 mile Moscow-Leningrad railway line.

NYASALAND

Funds Needed

To finance construction of a hydro-electric scheme at Nkula Falls, Nyasaland, the Federal Government of Rhodesia and Nyasaland is now exploring the possibility of borrowing £3 million. The site proposed for the project is 22 miles north-west of Blantyre, on the Shire River. Initially, it is proposed to install one 8,000 kW generating set, but there would be provision for the addition of a second machine within a few years. The Minister of Power, Sir Malcolm Barrow, C.B.E., has explained that, although at first there would be no need for a dam at Nkula, the proposed works would be designed to make a dam and another power station possible later.

S. AFRICA

Increased Surplus

Although the total number of units sold by the Cape Town electricity undertaking during 1958 only increased by 1·8%, due to a very mild winter, the operating surplus increased from £85,640 in 1957 to £291,646, thanks to an increase in tariffs to cover a 10% surcharge on coal railage. The number of domestic consumers increased by 2,831 to 85,584, but their average monthly consumption dropped 3% to 447 units. Work is now well ahead on the initial stage of the new Athlone power station, due for commissioning next year.

Pretoria's Progress

With the erection of the sixth 30 MW turbo-alternator, now in hand, the final stage in the completion of Pretoria City Council's "B" power station in Mitchell Street has been reached. By next year there will be in this station 180 MW of generating plant backed by 2,100 klb/hr of boiler capacity. The fifth generating set was put into commission last year. The final cost of this station will amount to about £10,000,000.

Good progress is also being made with the further station ("C") at Rooiwal, some 15 miles north of the city. The

civil engineering work was commenced on the site last October and by the end of March contracts for terracing the site, foundations, steel-framed buildings, turbo-alternators and condensing plant, turbine house crane, boilers, piping and transformers had been placed. The first stage of this new station comprises two 60 MW turbo-alternators (English Electric) with two 550 klb/hr boilers (Yarrow) and is estimated to cost £9,580,000. It is programmed to go into commercial operation before the winter of 1963. The station is planned for four 60 MW sets and four boilers and when completed it is expected to be the biggest municipal coal-fired power station in the southern hemisphere.

SINGAPORE

Another 25 MW Set

Associated Electrical Industries Ltd. have received an order from the Municipality of Singapore for a 25 MW turbine generator for Pasir Panjang power station. The order—valued at over £400,000—includes condensing plant and turbine supervisory gear. The new machine, scheduled for delivery in September, 1961, will be the seventh 25 MW set supplied by AEI for Pasir Panjang; of the previous six machines, ordered since 1947, the last was commissioned in 1958. Like the earlier sets, the new machine will consist of a two-cylinder turbine driving an air-cooled a.c. generator at 3,000 r.p.m. The initial steam conditions at the t.s.v. will be the same at 600 p.s.i.g. 800° F.

PAKISTAN

Dollar Loan

An agreement has been signed between the Government of Canada and the Government of Pakistan, under which the Canadian Government will contribute $3½ million towards financing and construction of the Shadiwal hydro-electric development project. The Canadian contribution will be in the form of equipment and technical skill and some material. The Shadiwal project envisages the generation of 12,000 kW of power, primarily for the operation of tube-wells to reclaim water-logged lands. The station will be situated near the Shadiwal village, which is five miles from Gujrat. The power station will consist of two 6,000 kW sets, and will have a firm output of 6,540 kW.

BURMA

H.E. Scheme

Burma's first hydro-electric plant was formally opened by the Industry Minister, U Thi Han, last month when he switched on the power supply from the Balu Chaung plant to Rangoon, at the sub-station 18 miles north of Rangoon.

The plant, costing 250 million kyat, has been erected at Lawpita in Kayah State, 250 miles north-east of Rangoon, to supply eventually 250 MW from the falls of the Balu Chaung river there. The plant has been constructed largely with the aid of Japanese reparations. Hitachi Ltd. have provided the turbines, generators, Toshiba Electric Ltd. the switchgear, and Mitsubishi Electric various transformers.

AUSTRALIA

Fuel Supplies

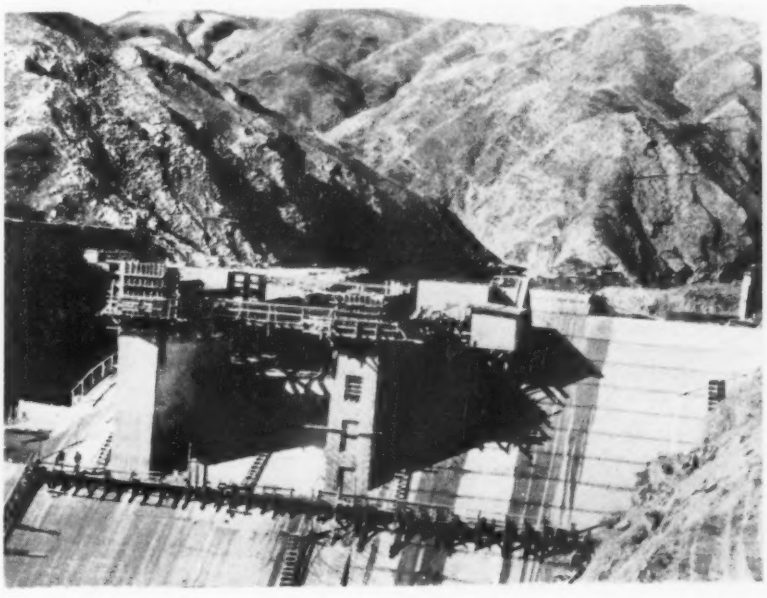
The NSW State Mines Control Authority and the NSW Electricity Commission are each to open a mine at Vales Point to supply coal for the new Vales Point power station. The latter station is initially to have two 200 MW generators, with a third to be added between 1963 and 1965. By that time, coal consumption is expected to reach nearly two million ton a year. It is to provide such supplies economically that the two new mines will be developed concurrently with the existing nearby mines of J. and A. Brown and Abermain Seaham Collieries. Announcing this, Mr Heffron, the Premier, said that extensive boring in the Lake Macquarie area had proved the existence of large quantities of coal suitable for electricity generation. The new mines would deliver coal direct to the power station by conveyor belt. They would be developed by the two organisations from their own funds. Incidentally, this will be the first time the Electricity Commission has used conveyor belts on a major scale for the transport of coal. Contracts have already been placed for the initial generating plant for Vales Point power station—English Electric Co. are supplying the generators, and International Combustion Australia, the boilers.

Underground work

A programme for putting high voltage cables underground in central Launceston will be launched later this year. The transfer is to be a gradual process, however, the Hydro-electric Commission of Tasmania has pointed out, for the cost of underground wiring is about six times that of overhead.

Live Line Detector

A new portable device which can tell from a distance of over 400 yd, whether a 132 kV line is live or dead, has been evolved by an engineer of the Electricity Commission of New South Wales. Designed to remove one of the dangers of rescue work in flood areas, the transistorised unit operates from a 4½ V battery and has been built into a 4 in. square box. The detector picks up the hum from live power lines, amplifies it many times and indicates its strength on a meter, we understand. It has been designed by Mr J. Dembecki, who admits that the principle is not new.



It is hoped that Pakistan's major hydro-electric project, the Warsak scheme, will go into operation this month with the first two 40 MW machines. Two more similar sets are expected to be ready in July. The Warsak scheme is also one of Canada's major contributions under the Colombo Plan—over $37 million in material, equipment and services has been provided by that country. A mass concrete dam has been built across the Kabul River which rises in the mountains of neighbouring Afghanistan. The dam is 760 ft long and 250 ft high, creating a lake some 1,000 ft in width up to the Afghan border, about 26 miles from Warsak. H. G. Acres and Co. Ltd., are the consulting engineers. The 132 kV transmission line from the station to Wah, a distance of 100 miles, was completed earlier this month. This is part of the 225-mile long Warsak Kharian section of West Pakistan's 750 miles of primary grid

Personalities *in the industry*

Mr L. C. Bruce

Mr D. W. Aldridge

Mr W. C. Handley

Mr F. J. Pearson

Mr J. Lunn

Dr D. H. Follett, M.A., PH.D., F.INST.P., Keeper of the Department of Electrical Engineering and Communications in the Science Museum, South Kensington, is to take over the directorship of the Museum on 1 May in succession to Dr T. C. S. Morrison-Scott, who is to become director of the British Museum (Natural History). Dr Follett joined the Science Museum in 1937 as Assistant Keeper, Department of Physics and has held his present position since 1957.

Mr L. C. Bruce, M.A.S.E.E., has rejoined Marryat and Place Ltd. as technical sales engineer for London and the Home Counties, and will specialise in the firm's Barduct and metalclad busbar products. He served his apprenticeship with that concern and, following experience with other firms, he has been with the Power Centre Co. in London dealing with busbar sales for the past eight years.

Chairman of the Telegraph Condenser Co. Ltd., **Mr D. W. Aldridge,** M.C., M.I.E.E., is to retire from that position following the annual general meeting on 4 May. He is to be succeeded in the post by **Mr W. C. Handley,** B.SC., M.I.E.E., and **Dr L. G. Brazier,** B.SC., PH.D., M.I.E.E., is being appointed to fill the vacancy on the board. Mr Aldridge, who is also deputy chairman of British Insulated Callender's Cables Ltd., the parent concern, was educated at Oundle school, Northampton, and served an apprenticeship with W. H. Allen, Son and Co. He started with British Insulated Cables Ltd. in 1913 and, after war service, became assistant superintendent of the Prescot Wire Mills. In 1932 he was appointed refinery manager, British Copper Refiners Ltd., in 1937 he became deputy works manager, Prescot and, three years later, was promoted to works manager. He was appointed to the board of BICC in 1945 and is also chairman of Painter Brothers Ltd. and deputy chairman of Philips Electrical Co. Ltd., of Ontario. Mr Handley, who joined the TCC board in February, 1959, started with British Insulated Cables Ltd. in 1923 following training at Lancashire Dynamo and Motor Co. He was manager of the Capacitor Division from 1941 to 1945, when he became director and general manager of an associated concern, the United Insulator Co. He was appointed liaison officer, Home Group activities, BICC, in 1949 and joined the board of that concern in 1951.

The following appointments, effective from 1 May, are announced by the Midlands Region of Philips Electrical Ltd. **Mr C. Pitcher** and **Mr G. H. Barton,** at present lamp and lighting group representatives, are to be sales engineers attached to Nottingham branch. **Mr J. E. Little-Jones** is to take over lamp and lighting representation in the Leicestershire territory, at present covered by Mr Pitcher, and **Mr D. J. Langton,** who joined the company as a sales assistant in the Birmingham office at the beginning of this year, is to take over the area previously covered by Mr Barton. Prior to joining Philips, Mr Langton worked in his family's electrical contracting business and for a time with Joseph Lucas Ltd., Birmingham.

General manager of the Bahamas Electricity Corporation, **Mr Alan Kennedy,** O.B.E., is to retire on 31 May after 33 years' service with the electricity supply industry in New Providence. His successor will be **Mr J. J. C. Bradbury,** A.M.I.E.E., A.M.B.I.M., who is at present deputy general manager. Mr Kennedy started his career with periods of apprenticeship with Crompton Parkinson Ltd. and Harland and Wolff, following which he was attached to the RN Air Service from 1916-18. He afterwards joined the Belfast Corporation Electricity Department, serving this undertaking for four years. During the next five years he gained additional electrical experience whilst managing an electrical contracting firm in Northern Ireland. Mr Kennedy first went to the Bahamas in 1927 when he became a member of the distribution staff of the Bahamas Government Electrical Department. He held successive progressive posts during the following years, being appointed deputy director in 1946 and director in 1950. With the formation of the Bahamas Electricity Corporation on 1 Oct., 1956, he was appointed the first general manager. He was awarded the O.B.E. in 1955. Mr Bradbury joined the Bahamas undertaking in 1956, relinquishing the post of technical assistant in the office of the deputy chairman (operations) at Central Electricity Authority headquarters, which he held for three years. Mr Bradbury served his apprenticeship with the Portsmouth Corporation undertaking. In 1948 he spent a period as assistant grid control engineer at the Bristol Grid Centre and returned to Portsmouth as a third assistant engineer in the System Operation Department of the Southern Division. In 1951 he transferred to BEA headquarters as an assistant engineer in the System Operation Department.

Mr F. J. Pearson, micro switch branch sales manager of Honeywell Controls Ltd., Birmingham branch, has been given the additional responsibility of developing sales, service and customer engineering in the machine tool industry. In addition, **Mr J. Lunn** has transferred from the company's Manchester branch to head office at Greenford to develop sales and services of new micro switch products. His immediate attention will be largely devoted to meeting the needs of the computer, business machine and control panel industries.

Mr C. J. Hind has been appointed engineering director of Ruston and Hornsby Ltd.

Wishing to concentrate primarily on fundamental research work, **Dr A. J. P. Martin** has relinquished his directorship of Griffin and George (Research and Development) Ltd., but has agreed to continue in the capacity of consultant. His successor as director of research is **Mr R. C. Palmer,** M.A., his present deputy.

Mr John H. Whitaker, A.M.C.T., A.M.I.MECH.E., has been appointed sales manager of Hagan Controls Ltd. He has had wide experience in the field of automatic control engineering, and joins Hagan Controls from Panellit Ltd. where, from 1956, he was sales director responsible for new techniques in data logging/computing systems. Previously he was sales manager of the Power Plant Division of Elliott Bros. (London) Ltd. Mr Whitaker has also been engaged in work connected with instrument and control systems for all types of industrial process plant at the Electroflo Metering Co. Ltd. Earlier in his career he was with the Chief Engineer's Department of the London County Council working on steam generation, pumping and heating and ventilation plant. During the war, holding the rank of major, he became deputy assistant director Mechanisms Engineer in REME.

Midland Silicones announce that **Mr J. E. Monaghan** has been appointed manager of the Rubber Sales Department at the London sales headquarters of the company. The appointment becomes effective on 2 May, when **Mr P. A. J. Gate** leaves the company to take up a position to start up a Technical Service Department for Pentachemical Industries (Pty.) Ltd., a subsidiary of Engelhart Industries (Pty.) Ltd. in Durban, South Africa. Mr Monaghan joined the Rubber Sales Department of Midland Silicones in 1955 from Petrochemicals Ltd., with whom he was a sales representative. He was appointed assistant sales manager of the Rubber Sales Department in 1958.

Mr Geoffrey Kennedy, partner in Kennedy and Donkin, who has been concerned in the Aswan hydro-electric scheme, last week received the award of the United Arab Republic Order of Merit, and returned to London from Egypt earlier this week.

Sales engineer in the Mining and General Engineering Division of the General Electric Co. Ltd., **Mr A. R. Sinclair** retired recently after 60 years in the engineering industry. He was the recipient of a presentation from colleagues at the Erith works.

Mr C. Blythe takes over Philips' lamp and lighting representation in North Nottinghamshire and North Derbyshire. Recently Mr Blythe was with the National Coal Board and for the past two years has been concerned with juvenile applicants in the training centre.

Dr Cecil Dannatt, O.B.E., M.C., D.SC., M.I.E.E., M.I.MECH.E., A.AMER.I.E.E., a director of Associated Electrical Industries Ltd., has been appointed vice-chairman with the special responsibility of co-ordinating both commercial and technical policy. He took up these new duties last Tuesday, when he relinquished the post of managing director of AEI (Manchester) Ltd. The latter position has been taken over by **Mr H. West,** A.M.C.T., HON.M.SC., M.I.MECH.E., M.I.E.E., M.A.M.E.M.E. Dr Dannatt, who is 63, joined the board of Metropolitan-Vickers Electrical Co. as director and chief electrical engineer in 1947. He was assistant managing director from 1951 to 1954, and also director of research and education until 1953. In March, 1954, he was appointed deputy managing director and became managing director in Oct. of the same year. He became chairman of Metropolitan-Vickers Electrical Co. in 1957. Mr H. West, who is also managing director of AEI—John Thompson Nuclear Energy Co., was, earlier, assistant managing director of Metropolitan-Vickers Electrical Co., whom he originally joined as an apprentice in 1918. By 1949 he had become chief electrical engineer and two years later was appointed to the board. He has been assistant managing director, AEI (Manchester) since last Jan.

Mr A. C. Ball and **Mr A. E. Gilbert** have been appointed directors of Hayward Tyler, a member of the Stone-Platt Industries group.

Formerly chief of sales (Electronics Division) of Bruce Peebles and Co. Ltd., **Mr Ronald S. Stiff** has joined Nuclear Enterprises (GB) Ltd. as sales manager. Mr Stiff has wide experience of business in the scientific and engineering fields. Twelve years with Ferranti Ltd. included two years in the Edinburgh research and production departments, five years as a member of the international technical sales staff and five years as personal assistant to the London manager. Eighteen months ago he returned to Edinburgh to become chief of sales (Electronics Division) of Bruce Peebles and Co. Incidentally, as part of plans for expansion of the activities of Nuclear Enterprises (GB) Ltd. **Dr R. W. Pringle,** PH.D., F.INST.P., F.R.S.C., is shortly leaving on a tour of the USA.

Sir Ronald L. Prain, chairman of the Rhodesian Selection Trust group of companies, has relinquished the chairmanship of the Management Committee of the Copper Development Association after 10 years in that office. He has been succeeded by **Mr E. C. Baring,** a director of the Anglo-American Corporation of South Africa Ltd., and vice-chairman of the Council of the Association of which Sir Ronald will remain as chairman.

OBITUARY

His wide circle of friends throughout the industry will learn with regret of the death on 13 April, at the age of 77, of **Mr C. Hubert Smith,** M.I.E.E., M.I.H.V.E., chairman and managing director of Heatrae Ltd. With the late Commander F. L. Newhouse he founded the latter company in 1920 (originally as Electric Fires Ltd.), after being works manager to Belling and Co. for four years, following 12 years' experience with the St. Marylebone Borough Council Electricity Department. While with the latter undertaking he invented the first-known immersion heater, loading 6 kW, for direct connection to the mains. By his energy and sound design he quickly established an enviable reputation for the firm, particularly in the heating and water-heating sphere, where he became a recognised authority.

Mr J. H. Jarman, chief engineer (sales) of Tufnol Ltd., has died aged 63. He joined George Ellison Ltd. in 1913 and, from their drawing offices, was transferred to Tufnol Ltd., later to be appointed chief engineer (sales). An authority on laminated plastics bearings, Mr Jarman presented numerous papers to engineering societies and represented the British Plastics Federation on committees of the BSI and also served on the committee of the Midlands Section of the Plastics Institute.

Mr R. C. M. Graham, M.I.E.E., formerly a member of the Switchgear Department staff of Johnson and Phillips Ltd., where he was instrument transformer designer, died on 12 April. He had served as the company's representative on many BEAMA and BSI technical committees, and retired from the company in May, 1959.

Mr J. H. Whitaker

Mr J. E. Monaghan

Dr C. Dannatt

Mr H. West

Mr R. S. Stiff

B.L.C. Evidence on Domestic Lighting

THREE per cent of the cost of a domestic building should be spent on the lighting installation. That is the British Lighting Council's recommendation to the Housing Standards sub-committee of the Central Housing Advisory Committee of the Ministry of Housing and Local Government, which is currently collecting opinions on housing standards. The evidence, published this week, stresses the claim of electric lighting to be regarded not only from the utility aspect, but also as a decorative and furnishing medium, which needs to be altered from time to time. The purpose of lighting is not only to provide a comfortable social atmosphere, but also to provide for the specific occupations carried on in the room, a consideration which almost always implies a need for more than one lighting point.

The need for a good level of lighting is argued with reference to accident experience in the home, with 3,558 people dying from falls in 1957, 839 of them falls on stars. Adequate electric lighting may be provided either by an installation of fixed lighting points or by a system of socket-outlets; usually both are required. The socket-outlet situation of course merges with that of the general electrical provision. So far as existing dwellings are concerned, it is suggested that steps should be taken, particularly at change of ownership, to bring to the attention of owners the deficiencies of existing installations, and to put forward suitable schemes of modernisation. It is also recommended that steps should be taken to ease the immediate financial burden of rewiring to modern standards.

Recommendations

On the basis of such considerations, the British Lighting Council recommends that a local planning authority should require new houses to be provided with an installation of fixed lighting points and socket-outlets "adequate to meet present needs and provide for the future." The minimum standard of adequacy put forward is that contained in BS Code of Practice 324.101, but there is in the present evidence a recommendation for a higher standard, as follows:

Kitchen: 2 fixed points, one over sink; 2-13 amp s.o.

Sitting room: 1 or 2 fixed points, and/or up to 4 wall brackets, a 13 amp s.o. on each side of fireplace, and one on every wall over 3 ft long. No point on wall more than 6 ft from s.o.

Dining room: As sitting room.

Bathroom: 1 fixed point.

Main bedroom: As sitting room for fixed lighting, with provision for lighting large cupboards. 4 or 5 13 amp s.o.

Second bedroom: Fixed lighting as main bedroom; 3 or 4 s.o.

Small bedroom: 1 fixed point and/or 1 or 2 wall brackets; 3 or 4 s.o.

Apart from these recommendations, there are suggestions for the hall and staircase, garage and entrances, etc.

Lighting on Stairways

It is recommended that two-way switching of lighting for staircases should be made mandatory, and that adequate facilities should be provided for the "sufficient and suitable" lighting of common staircases, landings and entrances to blocks of flats. There is a final warning that the installation of electric lighting should be carried out only by men fully qualified and competent to do so.

In so far as the sub-committee to which it is giving evidence is concerned with existing dwellings, the British Lighting Council recommend that steps should be taken to include adequate lighting in the schedule of standard amenities listed in the House Purchase and Housing Act, 1959 (along with such amenities as a fixed bath or shower in the bathroom, a hot water supply and satisfactory facilities for storing food). They also recommend that that the facilities granted by building societies for effecting improvements in older houses should be extended to cover modernisation of the electrical installation.

Appendices to the evidence look at the cost of lighting relative to other household expenses, and also the way in which the cost has fallen over the past few decades from one one penny for 83 candela-hours in 1922 to one penny for nearly 2,000 candela-hours in 1960.

BRITISH STANDARDS

Electric Discharge Lamps for General Purposes. *BS 1270 : 1960. Price 5s.* The second revision in 14 years, necessitated by the rapid development in all forms of discharge lamp, this standard is characterised by a considerable extension to the number of new discharge lamps which have appeared over the last eight years. New descriptions introduced are MCFA, MCFB, MCFE, MCFR and the sodium integral type SOI/-; NE/H (Neon) and ME/D have been dropped. It is perhaps surprising that the sodium linear lamp has not been included, although established now for nearly a year.

In the schedules the range of wattages has been considerably extended, no less than 29 new types appearing in Schedule A including 1,000 W ratings both for the 200-250 V and 350-450 V ranges. Schedule B, covering low pressure tubular fluorescent lamps, has been extended to include a new 1½ in. dia 3 ft 30 W, a 5 ft 50 W, and the 8 ft 125 W which is also listed with recessed double-contact lamp caps to an as yet unreleased specification. Average life has been upgraded to 5,000 hr for all types and sizes except sodium (4,000 hr) and some of the mercury tungsten B (3,000 hr). Efficiencies are up noticeably, particularly in the tubular fluorescents, where the much debated coding has been dropped.

Dimensions of lamps are now given in both English and metric values and there is a new table in Schedule B giving nominal electrical characteristics for MCF lamps and in Schedule A for other lamps when operated in conjunction with standard control gear.

General Requirements for Aircraft Electrical Equipment. *BS 2G.100 : Pt. 3 : 1960. Price 6s.* This is the third part of the revision to G.100, the first two parts of which were circulated in draft form a few weeks ago. Dealing with the characteristics of electrical power systems and equipment, Part 3 has, at the request of the industry, been issued in final form and has taken into account the requirements of modern high performance aircraft in the light of experience gained over the past decade. The standard is in four sections dealing with a.c. supplies, d.c. supplies, distribution and utilisation. For the first time, limiting values of voltage drop on 28 V d.c. and 200 V a.c. systems are laid down, but it is significant that no mention is made of 110 V d.c. systems such as have been used on two of the V-bombers and are still being advocated in some quarters.

American Machine Screws and Nuts below ¼ in. dia. *BS 3155 : 1960. Price 8s 6d.* A useful reference standard for those catering for American markets, this gives limits and dimensions of all the standard machine screws and nuts likely to be used in electrical appliances and so enables transatlantic users to replace broken or worn screws from home sources instead of having to search for British replacements.

Calcium-base greases. *BS 3223 : 1960. Price 7s 6d.* A new rationalised specification for calcium-base greases used as lubricants, this is strictly of interest to lubrication experts. It is not for the ordinary user and a warning is given against selection of grades without the advice of a technologist on the subject.

Copies of the British Standards noted above may be had from the BSI Sales Branch, 2 Park St, W.1. at the prices stated. Postage will be charged extra to non-subscribers of the Institution.

Cutting the cost of peak kilowatts

PEAK RATING FOR STEAM SETS, OR GAS-TURBINES?

THE argument that new methods of providing peak kW are necessary was developed* in our issue of 7 April. More details of one way US engineers feel that this situation will be dealt with are given in a paper, by Messrs F. A. Ritchings and R. R. Bennett (Ebasco Technical Services Inc.), entitled "Low Cost Incremental Peaking Capacity."

These engineers argue that an era is approaching which does not offer the large economic improvements in thermal efficiency to which the industry has become accustomed. Over the past two decades there has been an improvement in heat rate of about 3% per annum; for the foreseeable future this improvement is estimated at only 1% per annum. Steam conditions are considered to be on a "temporary plateau" of 2,400 lb/sq in., 1,050°F, with no significant improvement in heat rate possible without a substantial increase in investment. The argument is that to meet this situation, plant should be installed of a type that would keep existing reheat units in the lower portion of the load-duration curve for a longer time. This implies that generating plant should be purchased for a particular type of load service, e.g., gas-turbine generators for peaking. The paper is more directly concerned with "incremental capacity units" which are essentially base-load high-efficiency units able to produce peaking capability at low incremental cost.

Table I. Summary of Operating Conditions for Peaking Capacity Sets

Description *		A	B	C	D	E	F	G
Maximum Capacity	MW	250	314	335	350	350	350	286
Throttle Pressure	lb/sq in	2,000	2,400	2,400	2,000	2,000	2,400	2,000
Throttle Temperature	°F	1,000	950	950	1,000	1,000	950	1,000
Reheat Temperature	°F	1,000	950	950	977	1,000	950	1,000
Throttle Flow	klb/hr	1,715	2,139	2,139	1,715	1,715	2,139	1,715
Reheat Flow	klb/hr	1,559	2,120	2,120	2,764	2,713	2,678	1,995
Extraction Flow to Crossover Heater	klb/hr	141	0	0	0	0	0	0
Reheater Inlet Pressure	lb/sq in.	553	761	761	998	979	965	715
Reheater Inlet Temperature	°F	681	673	673	833	761	718	532
Feedwater Temp. to Steam Generator	°F	479	387	250	462	460	459	431
Exhaust Flow	Million lb/hr	1,205	1,655	2,120	1,991	1,966	1,929	1,502
Condenser Duty	Million lb/hr	1,150	1,526	1,983	1,835	1,825	1,768	1,423
Exhaust Loading	lb/hr/sq ft	9,773	13,423	17,194	16,160	16,150	15,650	12,182
Leaving Loss	BTU/lb	6·4	6·3	6·6	7·0	6·9	6·7	6·6
Back Pressure	in. Hg abs	3·5	4·5	5·8	5·0	5·0	5·0	4·0
Gross Turbine Heat Rate	BTU/kWh	8,025	8,337	9,467	8,845	8,623	8,466	8,400
Net Station Heat, Rate (Coal)	BTU/kWh	9,755	10,490	11,905	11,250	10,830	10,640	10,200

* A. Base unit, no peaking capacity. B. Throttle pressure increased, temp. decreased, two heaters out of service. C. Throttle-pressure increased, temp. decreased, all heaters out of service, separately fired economiser. D. Steam by-passed from superheater outlet to i.p. turbine inlet, top heater out of service. E. Steam by-passed from primary superheater header to reheater inlet, top heater out of service. F. Same as E, except throttle pressure increased and temp. decreased. G. Spray at reheater inlet to within 25°F of saturation, top heater out of service.

Incremental Capacity Units

There are several possible approaches to this idea. Some are compared in the paper on the basis of a 250 MW set with conditions shown in Table 1. For each of the methods studied in the paper, it is assumed that there is no increase in the size of condenser or extraction heaters and no increase in steam piping size except between boiler and turbine. Fundamentally, the idea is that there should be modification to the steam path of the turbine to permit higher flows and, in some cases, higher pressure.

The paper warns that no turbine manufacturer has as yet fully designed a steam path for the alternatives considered, so that the heat rate increase at normal rating shown in the table is a matter of conjecture. The opinion of one manufacturer is quoted, that "the heat rate increase would be in the neighbourhood of 1% at 250 MW and the same percentage at loads less than 250 MW." Again, not all turbine-generator manufacturers agree that the schemes proposed are practical, since the exhaust loading exceeds the limit of 13 to 14 klb/hr/sq ft of annulus area imposed by some designers. (It needs to be recalled that 3,600 r.p.m. machines are under discussion.)

Generators considered in the schemes discussed are based on normal maximum hydrogen pressure. No manufacturer has recommended increasing the pressure, and all have strenuously recommended against operation of generators at higher than normal temperature limits. Thus, the peaking machine has to have a larger generator.

Boilers have to have a higher furnace heat release at the peaking output, and wider furnaces may be necessary than for a 250 MW m.c.r. machine. Although they will operate with the same efficiency as an m.c.r. unit at the 250 MW output, at peak capacity this efficiency will be reduced by about 2% to 3%.

Cost Estimates

The paper discusses in detail the paths to extra peaking capacity outlined in Table 1. It gives estimates of cost of the extra peaking capacity that range (for gas firing) from $30 to $39/kW above 250 MW, compared with a cost of $102/kW for the base plant. Cost of a 100 MW unit for specific peaking purposes is estimated at $90/kW. To provide a unit with peak efficiency at about 350 MW would cost about $75/kW for the capacity above 250 MW. Costs for coal-fired plant would be slightly higher.

The principal disadvantage of such peaking schemes is seen as being the decrease in heat rate at the normal capacity (250 MW in the example chosen) and at lower loads. Assuming a loss in heat rate of 1%, then the capitalised cost of this would range from $2½ to $4 for 63% load factor.

Spinning Reserve

One manufacturer's approach to the question of peaking capacity is described by two General Electric Company

* "US Engineers Look to the Future of Generation," p. 575. That article, like the present summary, was based on papers presented to the recent American Power Conference, organised by the Illinois Institute of Technology.

engineers, Messrs J. E. Downs and E. H. Miller. In their paper, "Large Steam Turbine-generators With Spinning Reserve Capacity," they discuss in detail the extra capacity obtainable by increasing pressure. A study has been carried out on the basis of a 225 MW machine driven by a tandem-compound triple-flow turbine with three rows of 26 in. exhaust blades. Normal operation is at 2,400 lb/sq in., 1,000°F. The study investigates the possibility of increasing the pressure to about 3,150 lb/sq in. for peaking purposes, giving an increase in output to 312 MW. Initial and reheat temperatures are assumed reduced by 50°F to avoid the need to increase wall thicknesses of piping and casings by an excessive amount.

One result of the study is to show that boiler feed pump power will be increased by 92% compared with that needed for normal output. It is suggested that an auxiliary turbine would provide the best means of meeting this increase.

The authors discuss briefly the possibility of increasing peaking capacity through generating extra steam, by-passing the h.p. cylinder and introducing the steam at lower pressure.

For machines having a turbine heat rate of about 7,900 B.Th.U./kWh at the base load, it is calculated that 130% base load could be obtained with heat rates of 8,350 and 8,680 B.Th.U./kWh for the increased pressure and by-pass cycles respectively. The authors do not predict the probable economy of this approach in any detail.

Gas-turbine Peaking

A more conventional approach to provision of peaking power is installation of a gas-turbine generator. The economics of such a scheme are analysed in detail in a paper by Messrs J. O. Stephens and B. L. Lloyd (Westinghouse Electric Corp., Lester, Pennsylvania). Their basis is a 22 MW machine, and they look at this with reference to a system having a peak load of 1,000 MW, increasing by about 50 MW/year.

Amongst their conclusions is a statement that for a unit installed for true peaking duty, the production cost (mainly a factor of efficiency) of the unit is of little significance. Most of the penalty in terms of cost arises from having installed a peaking unit rather than a highly efficient base-load unit that would enable other conventional but less efficient units to be unloaded.

Noise

So far as design detail is concerned, the paper remarks that Westinghouse have been working for ten years with the comparatively conservative gas temperature of 1,350°F. The intention is to increase this to 1,450°F for peaking units. Another point concerns noise, a factor of some importance since peaking gas-turbines may be installed in residential areas to shave the peak with minimum transmission costs. The predominant noise with gas-turbines, the authors suggest, is in the 3 kc/s range, and "is very directional and easy to damp". They quote operators using both diesels and gas-turbines as saying that noise is more easily suppressed in the latter.

Estimated cost for a 22 MW set (summer rating) is $110/kW; for the equivalent winter rating of 27·5 MW, $95/kW. These estimates assume a remotely controlled plant requiring only switchgear and interconnectors to be added. Low start-up cost and operating flexibility are, of course, valuable advantages of such an installation.

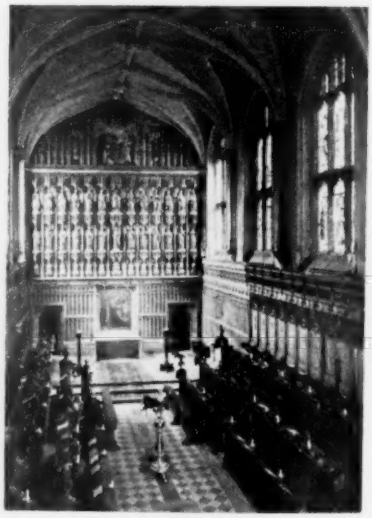
Electric heating for college chapel

EFFICIENT and discrete heating arrangements for historic churches and chapels is always something of a problem, but, in the case of that recently completed by the GEC at Magdalen College Chapel, Oxford, there was the additional worry of adjusting the temperature to the nicety required by the post-Cromwellian organ, which loses pitch if the temperature exceeds 62°F, only just above the minimum comfort level for the organist and congregation. How successful the new installation has been can be judged by the fact that Dr Bernard Rose, organist to the College, now finds that he can use certain stops which were quite unusable with hot-waterpipe heating and, even more important, it does not need tuning so often.

The Chapel was built in the middle of the fifteenth century and restored from Cromwellian devastations early in the nineteenth. The beauty of the architecture and the ornate woodwork of the stalls were both conceived with little regard for the comfort of the congregation and a great deal of thought and planning had to be expended before the present installation was decided upon. This involved the installation of 32·1 kW "Nightstor" units grouped 16-a-side under the stalls in the chancel, each bank being controlled by a thermostat set to cut-out at 80°F. This is necessary to prevent warping of the woodwork and to save the ornamentation, which is glued to the woodwork, from dropping off. For similar reasons, the heaters are downrated to 750 watts.

Nearly 20 kW of tubular heaters are mounted in double banks under the windows and these, loaded at 80 W/ft, bring the temperature up to the required level in a matter of hours, whereas the old solid-fuel system required up to four days. Accurate temperature control is effected by a MacLaren TRLB unit on the "Nightstor" heaters and temperature limit thermostats on the tubular heaters.

In the Ante-Chapel a further 38·25 kW of 2·5 kW "Nightstor" units, in long or deep patterns according to the situation, are installed in unobtrusive locations with tubular heaters under the windows. It is here that the organ is situated. The installation was carried out by the Southern Electricity Board in conjunction with the GEC, with assistance from the Senior Bursar's maintenance staff.



The chancel of Magdalen College chapel, Oxford

Tap-changer for 500 kV

NEW DESIGN ACHIEVES HALF-CYCLE OPERATION

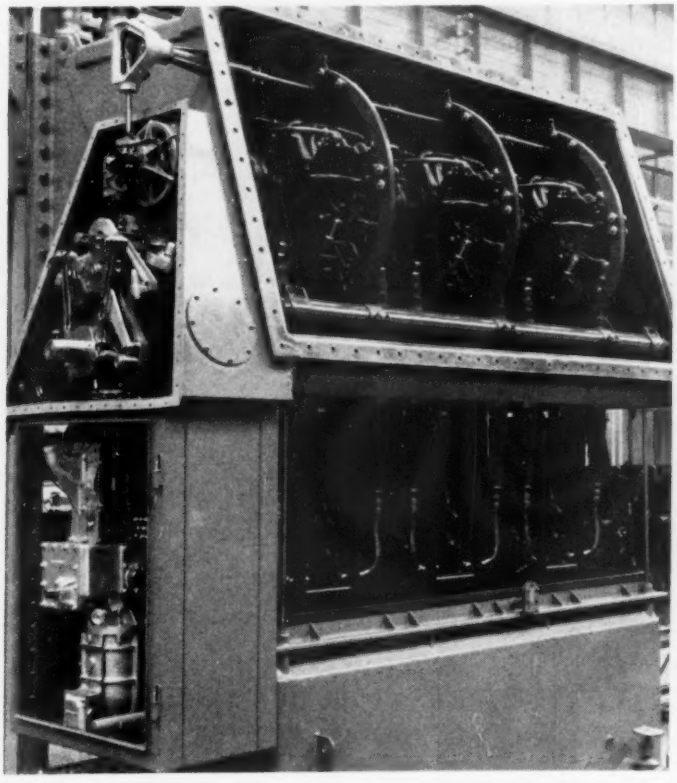
THE upward trend of operating voltage and load-carrying capacity of transmission systems imposes considerable difficulties on the equipment designer if his designs are not to become obsolete sooner than their expected useful lives. The designer must become a forecaster, deducing likely future requirements from present-day practice, and it is this sort of thinking which has gone into the design of a new high speed resistor tap-changer which English Electric have introduced. It anticipates future requirements in being capable of operation at system voltages of 500 kV and currents of 1,000 amps.

The design is also notable for the use of modern plastics materials. In the selector switch, the contact supports are made from quartz-filled, epoxy resin vacuum-cast mouldings. One moulding, in the form of a ring, carries five fixed contacts; another moulding takes the form of a spider, which rotates within the ring, carrying two moving contacts. A bank of three such arrangements on a common shaft, and with a changeover switch to give a maximum of 18 steps, is mounted in an oil-filled tank to form the selector unit. A second tank attached to the underside of the selector houses the diverter switches. Connections between the two and between the selector and the transformer are effected by special sliding-stem bushings which allow for expansion of the solid copper conductors to avoid strain being placed on other components.

The diverter switch mechanism has been designed to achieve half-cycle operation, which at 1,000 amp current rating requires high contact speeds. To avoid contact bounce (and consequent premature contact deterioration), low-mass contacts have been designed, moving under spring control. A rolling action, obtained by arranging for the point of contact always to lie on the line joining the centres of the two contact pivots, eliminates frictional wear. The sole factor in determining contact life is therefore arcing duty, which is restricted to arcing tips of sintered tungsten carbide. The switch assembly is carried on epoxy resin boards, which, being mounted vertically in the tank, present minimum surface for carbon deposition to minimise potential danger from this cause.

The operating mechanism displays several novel features in order to achieve half-cycle diverter switch operation in an overall tap-changing time of 0·06 sec. Energy required to achieve speeds of this order is obtained from a charged spring, the design being such that the spring is partially recharged at the end of the movement to absorb the momentum of the system and achieve smooth stopping. To guard against the possibility of spring failure, a "follow-through" mechanism is incorporated to complete the tap change at slow speed. Since the energy stored in the spring must be released at precise times, with maximum torque instantly available, a conventional sliding-action latch, in view of its wear due to the build-up of stress at the point of release, has been discarded in favour of a special toggle-action.

One of the chief aims of the design has been to reduce to as low a level as possible the frequency of maintenance. The extent to which this has been achieved may be judged from the results of performance tests; 100,000 operations of the diverter switch at full load, with 30 kV maintained across one contact support, gave no deterioration in electrical strength from carbonisation and a relatively small deposit of carbon on the condenser bushings. After 200,000 tap changes at 700 amp and 400,000 tap changes at 400 amp, the current-carrying copper contacts were unaffected by arcing. The diverter resistors (of non-inductively wound ribbon on ceramic supports) are capable of withstanding 50 continuous tap changes and full-load for five minutes.



English Electric's new 500 kV tap-changer showing selector switch assembly (top), diverter switch (below), and change mechanism (at left)

equipment for industry

High-speed counters

TWO high-speed electromagnetic counters have recently been introduced. These have six-digit indication, with optional manual or electrical reset. They are suitable for counting speeds up to 3,000 impulses per minute. The first version operates from d.c. impulses and the second, operating from a half-wave 50 c/s supply, is intended for use as a time indicator on the first counting wheel, with subsequent wheels giving decimal indication. *Lancashire Dynamo Electronic Products Ltd., Rugeley, Staffs.*

D.C./D.C. converters

FOR obtaining a high voltage d.c. supply from batteries, or similar low-voltage sources varying from 6 to 28 V, the Avel-Toroid Division of Aveley Electric are manufacturing a range of converters giving output voltages from 90 to 300 V. These units are rated from 2 to 120 W and incorporate toroidally wound transformers and selenium rectifiers. Overall efficiency is claimed to be 76% and ripple content of the output is very low. *Aveley Electric Ltd., Ayron Rd, Aveley Industrial Estate, South Ockendon, Essex.*

Timing and recording

FOUR timing and recording devices have been introduced recently by AEI. An event recorder and an hour meter are intended for establishing reliable records of times of switching on and off electrical equipment. The event recorder consists of a 15 day, clockwork movement driven chart with a solenoid-operated pen. The solenoid can be wound for mains or low voltage supplies so enabling the recorder to be independent of mains supplies if required. Running time of equipment is summated by the hour meter which includes a self-starting synchronous motor with a cyclometer dial. Both items are mounted in small sheet-steel cases.

A range of diesel engine protection panels has also been introduced recently for giving visual or audible warning of failure in lubrication and cooling systems. These three units are made by *AEI Radio and Electronics Components Division, 155 Charing Cross Road, W.C.2.*

Welding timers and control equipment are now being manufactured by the company in unit form, enabling units to be assembled in groups to suit particular requirements. These timer units are similar to those in use for several years for dekatron-controlled spot, seam and projection welding equipment. *AEI Electronics Apparatus Division, New Parks, Leicester.*

Transistorised thermometer

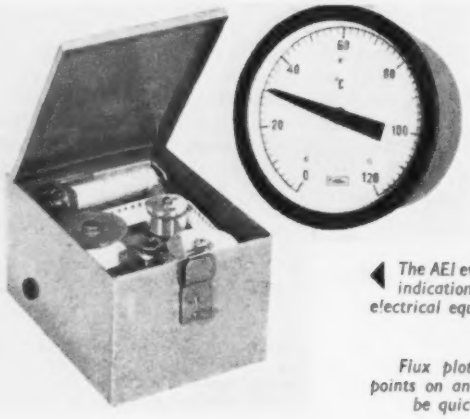
ACCURACY, convenience of installation and size comparable with the conventional mercury-in-steel thermometer are features of a transistorised temperature indicator recently added to the Fielden "Bikini" range. The instrument operates from a resistance bulb which may be as far as 100 yd from the meter and, because an operating frequency of about 2,000 c/s is used, there is no danger of false readings being caused by mains frequency pickup. The transistor control circuit is mounted in a sealed instrument case together with a simple d.c. servo motor which actuates the pointer. The price is said to be comparable with filled system or galvanometer indicators and an accuracy at f.s.d. of ½% is claimed, with a reproducibility of ¼%. Standard ranges are available over the effective operating range of the resistance bulb, i.e., from −200 to +500°C, but suppressed scale instruments can also be supplied. *Fielden Electronics Ltd., Wythenshawe, Manchester.*

Doubling-up motor output

APPLYING class E insulation to their t.e.f.c. induction motors in the range ½ to 50 h.p. has enabled Newman Industries to uprate some frame sizes by 100%. These motors are dimensionally interchangeable with ventilated machines to BS 2960. The range is covered in 12 frame sizes with 50 c/s speeds from 750 to 3,000 r.p.m. *Newman Industries Ltd., Yate, Bristol.*

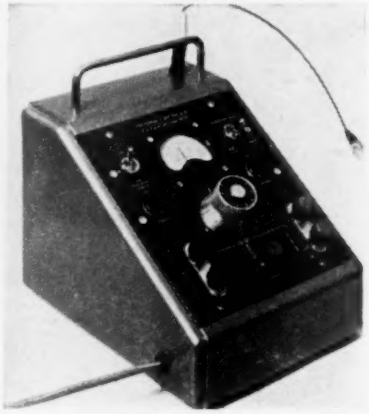
Analogue field plotter

IT is well known that the electrolytic tank has proved a powerful means of analysing electric and magnetic field problems arising in the design of transformers, bushings and other electrical equipment. However, the electrolytic tank may prove to be a costly piece of apparatus and, for certain simple problems which can be represented two dimensionally, special resistive paper on which representations of sections of equipment under investigation can be painted may give a quicker and cheaper analysis. To enable such field plots to be made quickly and simply, a field plotter has been introduced, consisting essentially of a resistance bridge. This bridge can be calibrated to indicate selected fractions of the p.d. applied between electrodes painted on the resistive paper. Although the method is well known in laboratories, the field plotter is believed to be the first instrument marketed commercially to exploit the technique and, at a price of £33, it is within the means of schools and colleges as well as manufacturers. *Servomex Controls Ltd., Crowborough, Sussex.*



Bikini transistorised temperature indicator has an accuracy at f.s.d. of ½%. The instrument operates in conjunction with a resistance bulb

The AEI event recorder gives a reliable indication of date and times for which electrical equipment is in use.



Flux plotter enables equipotential points on analogue resistive paper to be quickly and accurately determined

for the electrical trade

New fans

THE makers of "Breeza" fans and blowers have introduced a slightly cheaper range, known as "Summit." The four models, ranging from 6 in. to 9½ in. dia are suitable for mounting in any position with, or without, louvred shutters. Their shaded-pole motors have sleeve bearings lubricated by saturated pads, so that, under normal conditions, no external lubrication is needed. When necessary the pads are easily replenished.

These fans are obtainable either complete with three fixing arms or simply as motor and blades. A small extra charge secures a square mounting plate. Loadings up to 35 W. The two 6 in. models (1,350 and 2,300 r.p.m.) cost £4 10s complete, the 7½ in. (1,300 r.p.m.) £4 15s and 9½ in. (1,150 r.p.m.) £5. *London Fan and Motor Co., 27 Brecknock Rd, N.7.*

Refrigerator price drop

THE "Denmore 45" 4½ cu ft refrigerator introduced recently has been reduced in price from £68 15s 6d to £62 9s 6d. This table-topped cabinet is the largest of three models, all of which incorporate sealed compressor units. *Denham and Morley, 173 Cleveland St, W.1.*

Versatile electric jug

ANYTHING from carrots to coffee can be prepared in the new "Swan Brand" electric jug, an all-purpose heater for cooking and warming solid food or liquids. This appliance has a manually operated thermostatic control switch, providing a wide range of heat settings and protection against accidental overheating. Its capacity is 1½ pints, the interior being marked off in ¼ pints. A slot in the lid may be used to strain the contents when necessary. The body is polished aluminium with plastic handles in black or red. Loading, 600 W, price £5 10s. *Bulpitt and Sons, Icknield St, Birmingham 8.*

This "Swan-Brand" electric jug can be used as a cooking unit. £5 10s

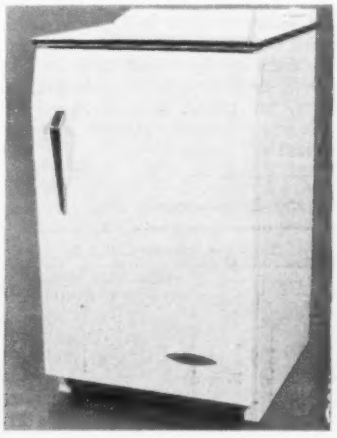
Pakamac refrigerator début

PAKAMAC'S opening contribution to the field of domestic appliances is a 4 cu ft refrigerator, "Pakamatic" PK 50. This is an absorption type model with 7½ sq ft of shelf area and the usual door racks for bottles and dairy goods. It has a removable egg holder. Zinc-coated sheet steel forms the outer shell and blue polystyrene the cabinet and door. "Pakamatic" stands 36 in. high, with a durable work top of melamine. Other dimensions are 22 in. wide by 25 in. deep. It is accompanied by a five-year guarantee. Loading 140 W. Price £57 12s. The next model in this range will be a 2½ cu ft cabinet. *Pakamac Special Products, Oldham.*

Projector lamps

THE most recent additions to the Siemens Ediswan range of projector lamps are two for 8 mm ciné and three with valve-type bases for 35 mm still projectors. The former, types, A1/186 and A1/193, are 12 volt 100 W units embodying filament coils roughly rectangular in shape, claimed to give a more uniform beam. Type A1/193, specially developed for the P.8M Eumig projector, has a non-standard cap type BA21s. Average life of both types is 25 hours, price 18s 3d list.

Types A1/182, A1/178 and A1/180 work from standard voltages at 150 W, 300 W and 500 W loadings. The first two incorporate coiled-coil flat grid filaments, the latter a "biplane" grid. They each have a life of about 25 hours and their list prices are 30s, 40s and 55s, respectively. *Lamps and Lighting Dept. of AEI Radio and Electronic Components Div., 39 Upp. Thames St, E.C.4.*



"Pakamatic", 4 cu ft table height model, £57 12s

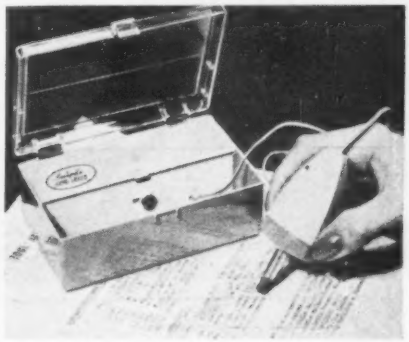
Mushroom growth

EKCO-ENSIGN, following the present trend towards modified lamp design, have produced a mushroom-shaped bulb with internal white finish. The range consists of three models, 60 W, 100 W and 150 W, costing 1s 8½d, 1s 11½d, and 2s 10d, respectively. *Ekco-Ensign Electric, 45 Essex St, Strand, W.C.2.*

Automatic eraser

A HANDY device for complete and rapid removal of typing errors is the "Auto Erase," a battery-driven spinning head in a small holder. Two U.2 torch batteries and a control switch are housed in a small plastic box, which also provides a home for the holder. The pencil-width head accommodates rubbers for either ink or pencil erasing. The advantage of this gadget is that it removes the marked surface through the speed of the rotating head without the need for arduous and messy scraping on the part of the user. Erasing is confined to the smallest possible area and it is claimed that the process need not smudge underlying carbons since only light pressure is needed. This appliance costs £2 10s. Extra rubbers, 2s a packet. *Badenia Calculators, Red Lion St, W.C.1.*

Typists' timesaver "Auto Erase" price £2 10s



TRADE PUBLICATIONS

ANDEC.—13-page booklet on transformers, F.H.P. motors for instrumentation, etc. Andee Ltd., Bennet Rd, Reading.

LONDEX.—48-page booklet on automatic controls. Londex Ltd., 207 Anerley Rd, S.E.20.

E.S.—Two leaflets on electrolytic conductivity cells and controller. Electronic Switchgear (London) Ltd., Letchworth.

CRABTREE.—Leaflet on inset mounted isolating switch-fuse. J. A. Crabtree and Co. Ltd., Lincoln Wks, Walsall.

SWAN-BRAND.—Revised price list of domestic cooking appliances, etc., from Bulpitt and Sons, St. George's Wks, Icknield St, Birmingham 18.

News of the Week

OLDBURY LARGEST NUCLEAR STATION ENVISAGED

550 MW first stage, followed by some 1,000 MW

OLDBURY-ON-SEVERN is likely to be the largest of the CEGB nuclear stations so far suggested. Although official approval for a 1,000 MW station had earlier been sought, it is now thought that considerably more can be accommodated. The first phase will be reduced to 550 MW, to be followed by a second station on the same land, capable of upwards of 1,000 MW.

This was revealed by Mr F. Faux, station planning and development engineer to the CEGB at the public inquiry last week into proposals for the Oldbury nuclear station.

Earlier, on behalf of the CEGB, Mr S. B. R. Cooke had explained that the Oldbury-on-Severn site, eight miles from the Berkeley nuclear station now under construction, was particularly advantageous, especially from the point of view of cooling water. The proposed site covered 175 acres of land and 350 acres of foreshore. The board already owned 93 acres and the remainder was covered by a compulsory purchase order.

Capacity of the station would be 550 MW as a first stage, although permission might be sought to increase that figure. It was proposed to construct a 350 acre reservoir on the foreshore to provide cooling water.

Oldbury-on-Severn was the seventh station in the Government programme of nuclear power stations, he went on. About 5,000 MW to 6,000 MW were contemplated by 1965-66, but that would probably not involve an increase in the number of generating stations—about twelve—because of the technical advances which have made it possible to build stations of high capacity.

The site was not in a national park, an area of outstanding natural beauty, a nature reserve, or of special scientific interest.

Objectors to the proposals included the Severn Estuary Fishermen's Association, the National Farmers' Union and the CPRE, whose evidence was given before Easter. The hearing is expected to be completed this week.

Schick in Britain

THE American manufacturer of electric shavers, Schick Incorporated of Lancaster, Pennsylvania (a subsidiary of Revlon), is to set up a new British subsidiary company to make and market a full range of electric shavers in the UK later this year.

Managing director of the new company is Mr G. C. B. Brown (formerly sales director of Timex), and the offices are at 86A Brook St, London W.1.

Ferranti-Bendix Automation Link

UNDER an agreement concluded between Ferranti Ltd. and the Bendix Aviation Corporation, of USA, Bendix are to sell and service in the US the new Ferranti systems of machine tool controls, comprising the transistor-hydraulic continuous path machine tool control equipment, numerical position control equipment and inspection machines.

Bendix plan to set up a computer centre initially in Detroit to supply magnetic tapes for the Ferranti equipment.

Fuse Firm acquired

ALL the issued share capital of Kenneth E. Beswick Ltd. has been acquired for £105,000 cash by the Melbray group. Kenneth E. Beswick and its subsidiary, Beswick (Exmouth) Ltd., are manufacturers of small specialised cartridge fuses for the electrical, radio and electronic industries.

Spending on Research

EXPENDITURE on research by the electrical engineering and electrical goods manufacturing industry stands high in an industry-by-industry list published last week by DSIR. On a basis of research and development expenditure, expressed as a proportion of net output, the industry stands third with 9·8%, compared with 35·7% for the exceptional case of the aircraft industry, and 10·7% for precision instrument manufacturers.

The electronics manufacturers, who are included in the general electrical figure spend 11·9%. These estimates apply specifically to the year 1958 and are based on a questionnaire sent out to 502 companies last year; 292 replies were received.

DSIR estimate that British manufacturing industry spent £300 million on research and development in 1958, 95% in its own establishments and 5% on payments to co-operative research associations, universities and the like; for the electrical industry, proportions were 96% and 4%, respectively.

It is reckoned from the figures, in comparison with those for 1955 obtained in an earlier survey, that the research and development effort has more than kept pace with the change in value of production. Whereas in 1955, nearly two-thirds of such expenditure was paid for with defence contracts, in 1958, the proportion was less than half.

One of the more important results of the inquiry is cost of research per qualified worker. This is shown in the table, where the meaning of that term is indicated. In 1955 the estimate was £5,600 for all industry, and the inference is that more supporting staff are being made available to each qualified worker in research and development, and that more elaborate equipment is being used.

The table indicates the present breakdown of supporting staff, with the separation holders of HNC and HND who do not come in the fully qualified classification. The expenditure figures per worker for the electrical industry is not so high as in several other industries; but the number of qualified workers is nowhere exceeded. Also, the proportion of qualified workers on research work is higher than for most other industries.

Costs and Staffing for Research and Development

Industry	Cost per qualified* worker	Qualified workers in R & D	Total employment in R & D			
			Total	Qualified	HNC & HND	Others
	£			%	%	%
All mfg. industries	10,791	26,225	113,508	23	12	65
All mfg. industries except aircraft	7,968	22,977	95,644	24	12	64
Non-electrical engineering & shipbuilding	8,472	3,307	15,612	21	14	65
Electrical engineering & electrical goods	7,472	7,677	31,848	24	13	63
Electronics (included above)	7,908	2,996	10,175	29	11	60

* *"Qualified" workers are, broadly speaking, those with university degrees, Dip. Tech., or an exempting examination for graduate membership of a professional institution.*

A.E.I. link with Reyrolle & Parsons

AGREEMENT has been reached between AEI Ltd., A. Reyrolle and Co. Ltd. and C. A. Parsons and Co. Ltd. for a joint programme of research and for the exchange of technical information and experience in the field of generating plant and ancillary equipment. At the same time a financial link has been established between the three companies, although they will continue to trade in competition.

At present Reyrolle own 40% of the Ordinary shares in Parsons, and AEI has agreed to acquire from Reyrolle half its shareholding amounting to 1,800,000 Ordinary shares of £1 each, namely, 20% of Parsons issued Ordinary share capital. In return AEI will issue to Reyrolle 1,525,000 Ordinary shares of £1, each credited as fully paid from their unissued capital.

After this transaction, the issued Ordinary capital of AEI will total £42,828,595, of which the shares issued to Reyrolle will represent just over 3½%. AEI will not receive any dividend from Reyrolle, nor will the new AEI shares issued to Reyrolle rank for 1959 dividend.

As AEI's authorised share capital still unissued is now nearly exhausted, shareholders are to be asked to approve an increase of 3,000,000 unclassified £1 shares at an extraordinary general meeting to be held on 5 May next. This increase will enable AEI's directors "to deal with any opportunities which may occur, although they are not aware of any at the moment," states Lord Chandos, AEI's chairman.

£360 damages against E.T.U.

£360 DAMAGES for breach of contract, and costs, estimated at £2,000, were awarded to Mr J. H. Payne against the Electrical Trades' Union in the High Court last week. In a reserved judgment, Mr Justice Ashworth held that Payne's purported exclusion from membership of the ETU as from 20 September, 1954, was null and void. (The hearing was reported on 31 March.)

Mr Justice Ashworth ruled that the Birkenhead branch meeting when Payne was accused of doing "black" work during a strike at Capenhurst was "contrary to natural justice" because the nature of the charge was not sufficiently made known or appreciated by those adjudicating it. But he rejected Payne's allegation that he did not get a fair hearing, and held that counsel's description of the meeting as "a burlesque of a trial" had not been made out.

There had also been two breaches of the rules concerning appeals. Although the branch secretary had been ordered to expunge the record of the irregular committee meeting, he had not done so. That was inexcusable in view of the fact that the book was forwarded to union headquarters, the judge said. Even more reprehensible was the fact that Payne's shop steward, Mr J. Berry, had given evidence at the committee meeting in his favour, but this was not recorded.

The judge held that the conduct of the branch involved a serious contravention of union rules for which no satisfactory explanation was offered.

It has been revealed that the ETU paid £400 into court as an offer of settlement—without any admission that Mr Payne was still a member.

. . . and threat of legal action

Faced with the threat of legal action by Mr L. Cannon for the restoration of his rights within the Electrical Trades' Union (he is debarred from holding union office for five years), the leaders of the latter are now expected to tell the TUC that the proposed judicial inquiry into allegations of ballot-rigging would be out of order.

This latest development was revealed following last week's meeting of the Executive Council of the ETU, who had been given until 25 April to reply to suggestions by the TUC General Purposes Committee that the ETU should either take legal action against those who had made the allegations, or submit to an inquiry by a person of judicial standing. (Subsequently Mr Cannon offered to withdraw if the ETU agreed to allow the judicial inquiry to proceed.)

Pakamac plan appliance expansion

FURTHER expansion in the domestic appliance field is planned by Pakamac Ltd., Mr Leonard Cohen, managing director of the group, stated last week when introducing the new Pakamatic refrigerator (for details see page 661). A new company, Pakamac Special Products Ltd., has been formed to manufacture and market domestic equipment, and a disused cotton mill at Chadderton, Lancs, has been taken over for conversion into a modern factory having 200,000 sq ft of floor space.

The firm plan to market a second refrigerator model by the end of the year, and produce "other types of domestic equipment."

Growth of S.I.M.A.

THE following firms have recently become members and associate members of the Scientific Instrument Manufacturers' Association.

Full members: Wilkinson Sword Co.; Claude Lyons; Bruce Peebles and Co.; Nagard. *Associate members:* Amplivox; B and R Relays.

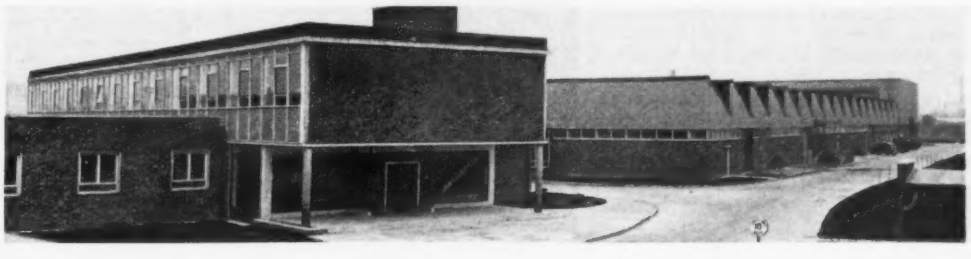
This brings the total to 149 full members and 30 associate members, making a grand total of 179 firms in SIMA.

Lampshade Makers reorganise

TO widen the scope of its activities, the old established Lampshade Manufacturers' Association has changed its name to the Decorative Lighting Manufacturers' Association. Membership is still limited to manufacturers of decorative lighting, as the association feels that this section of the trade should have its own organisation to deal with Government departments and other official bodies.

Plans of the newly constituted association include the formation of an exhibition group to organise trade fairs and stock rooms in various centres on a collective basis, the smoothing out of raw material shortages, the provision of information on supplies of plant and materials, the stimulation of bulk buying projects, the improvement of safety standard specifications for domestic lighting, import and export problems, packaging and transport problems, and co-operation between manufacturers in matters of common interest to the trade.

Earlier this year Mr J. R. Aldam was appointed secretary of the association in succession to Mr P. A. Platten. The offices are at 69 Cannon St, E.C.4.



The first stage of Yorkshire Electricity Bd's new 7½ acre Central Depot in Clough Rd, Hull, officially opened recently, provides spacious facilities for the repair and maintenance of commercial and domestic apparatus. Future extensions will include a large transport garage and workshops. Floor-warming is in use throughout

E.A.W. questions users on appliances

A TABULATED questionnaire, seeking the views of women on the design and performance of domestic electrical equipment in their homes, has just been circulated by the Electrical Association for Women. The 24-page survey—Electrical Viewpoint—is intended to provide an opportunity for suggestions on improvements or developments which could aid manufacturers, but criticism and comment generally is also sought.

The questionnaire is in two parts. Part I seeks information from users about the equipment they possess, including the make of washing machine, type of vacuum cleaner, clothes dryer, iron, cooker, refrigerator or kettle, together with its service record. Other details are sought of the type of electric space heating, water heating, and of the wiring installation. Part II provides scope for personal opinions and comments.

Branches of the EAW have already been holding meetings at which members have discussed the subject at length in preparation for completing the questionnaire. Other women's organisations, and the public generally, are also being invited to take part in the survey, which, judging by the searching questions needing completion, should provide some very useful data. The EAW hope to issue a report on the survey early next year.

Radio Trade Test postponed

DUE to difficulties in arranging for the use of the "Trainer Tester" servicing examination cards, this year's Radio Servicing Practical Test, arranged by the Radio Trades' Examination Board, has been postponed until 17 Sept. and 1 Oct., when actual radio receivers will be used.

Because of the problem of obtaining an adequate number of receivers, only those candidates who succeed in the written examination (the results of which will be announced on 16 Aug.) will be required to take the practical test. Those who fail the written paper will be credited with 1 gn towards their re-entry fees for next year's examination.

£500,000 Oxygen plant order

ORDERS to the value of nearly £500,000 have been placed with AEI's Heavy Plant Division by British Oxygen Engineering Ltd. for centrifugal air compressors and driving motors to be used in various tonnage oxygen plants which are to be built at four different sites in the country.

Six centrifugal compressors have been ordered, each rated at 20,000 cu ft of air per minute with a discharge pressure of 75 lb/sq in. gauge. These will be driven through speed-increasing gears by four-pole 11 kV synchronous motors. In addition, six 11 kV synchronous induction motors are to be supplied by AEI for driving high-pressure reciprocating compressors, also used in oxygen making plant.

60 years of Manufacture

A 64-page booklet entitled "The Allen West Story" has been published to mark the company's golden jubilee in manufacture. The company was incorporated on 15 April, 1910, by the late Mr Allen West, and the history tells how its early success was centred on design of a contact finger for heavy service drum controllers.

The story of the firm is taken up through the two world wars to the present day where the company is concerned with such topical contracts as those for the P and O liner *Canberra*, and the Bradwell and Trawsfynydd nuclear power stations.

Apart from its success in this country, the company's equipment is widely used overseas, with £1 million in direct sales annually.

CLEAN HEAT

THE use of electricity for water heating and floor-warming and its particular suitability in Smoke Control areas, will be the main feature of EDA's stand at the Health Exhibition to be held in Torquay from 25 to 29 April.

No flooring-warming grumbles in Leeds

TENANTS of municipal flats in Leeds which have electric floor-warming installed are "all perfectly happy and have no grumbles," Councillor K. C. Cohen, chairman of the Housing Committee, told Leeds City Council last week. "Some have found from experience that infrequent use of the underfloor heating, but more use of the electric wall fire, produces conditions to their requirements. Costs vary from 11s to 15s per week."

He was commenting on a recent newspaper report which suggested that tenants were not satisfied with the system, and that costs were such as to preclude its use.

The Housing Committee had decided that floor-warming should be installed in all multi-storey dwellings "in the extensive programme now being carried out."

Dinner 1760 Style

FIRST event in the bicentenary celebrations of the family firm of Geo. Salter and Co. took place last week with a dinner to the Press. To recreate the atmosphere of 1760 the programme included a stage coach ride from Birmingham to the old coaching inn at Handsworth, and an unfamiliar and lengthy menu served by candle light with traditional setting and costume. Celebrations marking the 200-year history of the firm will take place in June next.

Automatic Control in Steel-making

AN automatic power input controller developed by British Iron and Steel Research Association is being installed by Steel, Peech and Tozer to control a five-ton electric arc furnace.

In an electric-arc furnace, the temperature of the roof refractories is a good guide to the efficient use of electrical power, because unduly high temperatures indicate that power is being wasted. A furnace operates at optimum efficiency when the furnace voltage is regulated to suit each stage of the steel-making process and condition of the charge.

BISRA investigations have specified these voltages for particular furnaces and have shown that the change of voltage can be made automatically so that the optimum voltage is used at each stage.

The equipment developed consists, primarily, of a synchronous electric timer and devices which continuously measure the temperature and rate of temperature change of the roof refractories.

When the information relayed by these instruments indicates that a particular stage of melting has been reached, the controller selects the appropriate voltage for the next stage of the programme.

This mobile demonstration unit, designed by R. A. Lister and Co. for loan to dealers in rural districts, shows that electric power in the compact and economic form of a generating set is available for areas without a mains supply. Each unit comprises a 1·75 kW Lister "Start-o-Matic" diesel generator installed in a cream and maroon painted trailer. The generator starts automatically as soon as a load is switched on, and stops when the last item in use is switched off. The Lister 1·75 kW set is the smallest of a range which extends to 8 kW

Russian Welding Papers to be Published

ENGLISH cover-to-cover translations of two leading Russian technical journals dealing with welding are being published by the British Welding Research Association under a scheme sponsored by DSIR.

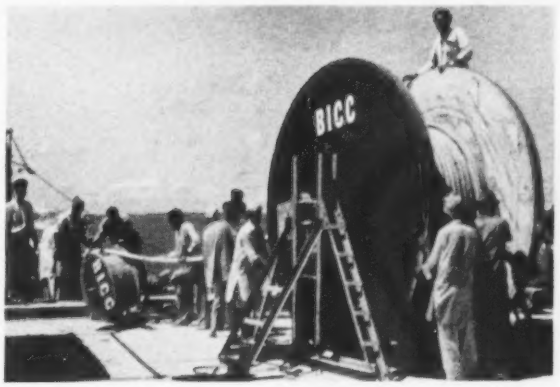
Russia is currently engaged in an all-out drive to develop welding. An authoritative article recently published by one of the journals being translated, stated:

"The wide adoption of these methods (submerged arc, resistance, electro-slag and gas shielded arc welding) is to be the basis on which mechanisation of welding processes in our national economy will be quadrupled between 1958 and 1965. Our country leads the rest of Europe in the use of mechanised welding methods, and we have outstripped the USA in the employment of submerged arc and electro-slag welding."

English titles of the two journals concerned are *Automatic Welding* and *Welding Production*. Annual subscriptions for the translation versions will be £10 10s and £5, and they are obtainable from the Publications Dept., British Welding Research Association, Abington, Cambridge.

Pumps for Drakelow "C"

FOUR groups of boiler-feed pump sets are to be supplied by Harland Engineering for Drakelow "C" power station, under a CEGB contract worth £375,000. The groups comprise main, standby, and starting units, including booster and feed pumps with 3,000 and 5,000 h.p. motors and turbine-driven feed pumps to operate in conjunction with two 350 MW turbo-generators.



BICC submarine cable being laid offshore by local workers on Gan Island in the Addu Atoll of the Maldive archipelago in the Indian Ocean where the RAF are constructing a staging post. The cable is being laid to carry power from Gan to Hittadu Island for the operation of a radio station, and comprises 13,000 yd of 3-core 11 kV paper insulated lead sheathed cable, protected by bronze-copper tape from the teredo worm which attacks the lead sheath of the cable.

"Which?" looks at 21 vacuum cleaners

UPRIGHT vacuum cleaners are more efficient at cleaning carpets than the cylindrical or "tank" types, and even the best tank is only as good as the worst of the uprights for carpets, though superior in other kinds of cleaning. This is the conclusion reached by the Consumers' Association after testing 21 out of more than 100 different vacuum cleaners on the market. The results of the tests, devised to compare performance and design, appear in the April issue of the CA's journal, *Which?*

Suction varied greatly in the models tested, CA reports. With most of the cleaners suction dropped by up to 40% when the bags were only half full of dirt, and in two cases there was no suction at all at this point.

To test endurance all 21 models were mounted on a frame which moved backwards and forwards over Wilton carpet, the motors being switched on for 30 min and off for 15 min day and night for nearly two weeks—the equivalent of 18 months' ordinary use. All survived the test (except the small Vactric P590 which broke down after 56 hrs), but the drive belts on the upright models had to be replaced periodically and had an average life of 34 hrs running time. Electrical safety tests showed four of the models tested to have minor electrical faults, while two were considered to be electrically unsafe.

Vacuum cleaners have little wearing effect on carpets, the report concludes. In fact, a carpet would have a shorter life if a vacuum cleaner was not used.

As a "best buy" among the upright models the CA recommends the Hoover de luxe 652 (which is also the dearest), and found the cheaper models all "reasonably satisfactory." Best buy among the tank types is the Parnall Vibra-Beat 1010, with the Hoover Constellation 862 and the Electrolux 65 as runners-up, while the Hoover Cylinder 417E and the Goblin Ace G71 are also regarded as" very good value for money."

EUROPE'S UNEVEN TRADE

THE uneven expansion of trade in Western Europe is noted in the economic survey of Europe in 1959, prepared by the secretariat of the United Nations Economic Commission and issued last week. The predominant factor was the growth of trade between the countries of the Common Market, which accounted for 73% of the rise in imports and for almost 80% of the increase in exports in European trade generally.

The survey observes that the trade increase between Common Market countries was accompanied by a significant trade diversion and adds: "Particular interest attaches to the development of West German imports, which accounted for about two-fifths of the rise in intra-Western European trade and for more than half of the rise in imports of Common Market countries from Western Europe. It seems likely that trade inside the Common Market has intensified largely in response to the first stages of the implementation of the Rome treaty and—doubtless more important—in anticipation of the further stages of this process."

Most outstanding feature of the economic picture in 1959 was the maintenance of price stability to a degree unusual in the post-war period. Industrial expansion had not been supported to any significant extent by expectations of a rising price level.

OFFICIAL PUBLICATIONS

BS 3234. Polythene insulation and sheath of electric cables. 4s.

British Standards Year Book, 1960. 15s.

Industrial Research and Development Expenditure. DSIR Report. HMSO. 1s 3d (see page 662).

BS Amendment Slips:

52. Dimensions of bayonet lampcaps, lampholders and lampholder plugs, PD 3698; 559, Electric signs and h.v. luminous discharge tube installations, PD 3688; 626, Micanite for commutator separators, PD 3672; 1975, Primary cells and batteries for intrinsically safe circuits for coal mines, PD 3707; 3187, Electrically conducting rubber flooring, PD 3705.

Mexborough 'fridge protest

A STRONG protest is to be made by the Mexborough Chamber of Trade against a scheme to install refrigerators in the town's 2,000 Council houses on a weekly payment basis. Mexborough Urban Council, it was alleged, were "going behind the backs of local traders."

At a meeting of the Chamber, Mr T. Jackson said: "These cut-throat tactics are grossly unfair. How are we to know that the Council won't start selling television sets and washers?

Another member, Mr H. E. Clay, said: "It would not be so bad if the Council bought from local traders, but they will go direct to the makers."

Connecting Welsh Farms

BY 31 March, 1963, it is expected that 38,000 farms (or 82% of the total) in Wales will have been supplied with electricity, the Minister of Power stated in the Commons last week.

BARRY LOOKS AHEAD

A SCALE model of the coastal area of Barry, Glamorganshire, showing how it might look in the future after extensive development as a tourist centre, was the highlight of an exhibition at Barry Memorial Hall recently. Siemens Ediswan lighting engineers co-operated in providing special lighting effects which would form an attraction at night, as illustrated in the picture above.

The effect of floodlighting and other illumination was successfully conveyed on the model by the employment of a technique of "visual emphasis," developed by Siemens Ediswan lighting engineers. Floodlit areas and points of illumination were picked out in fluorescent paint that was invisible under ordinary "daylight" illumination. For night effect, ultra-violet light was directed on the model to produce realistic illumination. Full sunlight and sunset conditions were also effectively simulated.

Class A and B "street lighting" was installed in the form of 400 tiny 3·2 volt medical lamps, transformer-fed from mains supply. The lamps, only ¼ in. long, were spaced to scale and lit to the correct relative Class A and B intensities.

Dignitaries from other towns, architects and municipal engineers attended the opening of the exhibition, which remained on public view for a week, and attracted considerable interest.

50 gns for Appliance Fair Symbol

A PRIZE of 50 gns is to be awarded for the best design for a symbol to be used in press and poster advertising for the first Electrical Fair which will be held at Alexandra Palace from 23 Sept. to 1 Oct. The symbol should be identifiable with domestic electrical appliances, state the organisers, who have circulated details of the competition to art schools and colleges throughout the country.

User Experience of Electronics

A THREE-DAY conference on "User Experience of Electronics in Industry" is to be held at Olympia, from 24 to 26 May next, when the Instruments, Electronics and Automation Exhibition is in progress. The conference is arranged by the Electronic Forum for Industry, which consists of nine associations of manufacturers in, or pertaining to, the electronics industry.

Sessions have been planned under the following headings: 24 May, Electronics in Data Processing; 25 May, Electronics in Factory Applications; 26 May, Electronics in Instrumentation and Control. Tickets for the conference at £1 11s 6d per session, covering admission to the exhibition and a report of the proceedings, are obtainable from the secretary, Electronic Forum for Industry, c/o The Electronic Engineering Association, 11 Green St, W.1.

U.K. Electronics in Rome

A DISPLAY of British electronic products is currently being staged by the Board of Trade at the International Samples Fair in Milan. Exhibits have been contributed by individual firms and have been selected to portray the theme "British electronics in the service of mankind."

The display covers 3,200 sq ft and has been organised for the Board of Trade by the Central Office of Information. The British Consulate-General and the British Chamber of Commerce in Milan are staffing a trade inquiry counter on the stand.

Electrocution: Ice Firm fined

A FATAL accident in an ice manufacturing plant at Hull, in which a fitter was electrocuted after touching an electrically driven compressor trolley, resulted in a fine of £100 being imposed on the firm by the Hull Stipendiary Magistrate last week. The firm, Hull Ice Manufacturing Co. Ltd., pleaded guilty to charges of failing to take adequate precautions to prevent the trolley becoming "alive" and make proper earthing arrangements.

It was stated in evidence that the fitter, named Dearden, was electrocuted one morning while holding the handle of the trolley. Sparks were coming from the wheels. Rescuers received shocks when they touched Dearden and the switch was live, so that some time elapsed before another switch could be located and Dearden released. He was found to be dead.

The firm, it was alleged, failed to "bush" a junction of cable into a switch-box; eventually the cable frayed and the switch and trolley became live. The earthing system was a wire attached to a rusty nut on the trolley, which became loose and functioned intermittently.

For the defendants it was stated that the fact that the trolley became live when the earthing system failed to function was an unfortunate coincidence. The employee who rigged the machine did not anticipate that it would be moved about. Had it not been moved, the accident would not have occurred.

Classes for Apprentices

A SMALL number of classes are to be set up in Government training centres to provide first-year apprenticeship training for boys accepted as apprentices by firms which have hitherto found it impracticable to undertake training or increase their present number of apprentices, the Minister of Labour announced in the House of Commons last week.

No charge will be made for the training provided, but employers taking part in the scheme will be required to give an undertaking to pay the wages of apprentices during the year and to continue the boys' training afterwards under normal industrial arrangements. The course will be full time, but the usual provision for day release will apply during the year.

The scheme has been approved by the British Employers' Confederation and the TUC, and the establishment of classes in engineering has been agreed by employers and trade unions in that industry. In due course the scheme will be extended to other trades.

The first training places will be available early this summer at eight Government training centres, at Aintree, Birmingham, Bristol, Cardiff, Hillington, Leeds, Letchworth and Long Eaton. Classes at other centres will be set up later this year, making a total of some 300 training places. Estimated cost of the scheme in the year 1960-61 is £25,000, with some additional expenditure for equipment to be provided at the Government training centres.

Electrostatics Conference

ELECTROSTATIC forces and applications of electrostatic techniques are to be the subject of an international conference at the University of Grenoble, France, from 27 Sept. to 1 Oct., this year. Further information may be obtained from Professeur N. J. Felici, Secretaire, Institut Fourier, Place Doyen-Gosse, Grenoble (Isere), France.

Course on h.v. transmission

HIGH voltage transmission is to be the subject of a course at King's College, Newcastle (University of Durham), arranged in collaboration with the N.E. Centre of the IEE. There will be six lectures beginning Monday next, 25 April.

The lectures are entitled: Hypothesis (financing and economics considerations, design methods, etc.); Synthesis (relation to existing systems, security of supply, etc.); Analysis; Characteristics of Main Equipment; Protection, Control and Communication; and System Performance Operation. Information may be obtained from the Director of Extra-Mural Studies, Joseph Cowen Hse, 153 Barras Bridge, Newcastle upon Tyne 1.

Sayings OF THE WEEK

"The time has come for the smaller [cable] companies to counter-attack and 'hot up' the competition. In view of the losses admitted and the panic measures being taken, there would be no harm in the order books of these giants [groups] being extended further with equally uneconomic business." . . . W. L. WRAY, writing to the *Financial Times*.

"Given reasonable care in use, and servicing and repair when needed, there is no reason why a vacuum cleaner should not give you fifteen years of use." . . . From the report of the Consumers' Association Ltd.

"It seemed possible to estimate saturation point in population, traffic and other things, but with electricity, nobody seemed to have any idea." . . . MR C. D. BUCHANAN, of Ministry of Housing and Local Government, at Oldbury-on-Severn inquiry.

PRICES of cable metals and other materials

Figures quoted are the official prices ruling on Tuesday, April 19

	£ per ton	Weekly change £
COPPER, standard class A (settlement) ...	265½	+6½
,, (3 months)	245½	+3½
LEAD, refined pig, 99·97% purity (cash)	77½	+½
,, (3 months)	76½	+½
TIN, refined, min. 99·75% purity (settlement)	787½	−1
(3 months)	784½	−1½
ALUMINIUM, ingots 99-99·5% ...	186	—
,, wire bars (4×4×54")	209	—
BRASS Strip 63/37	229	+7½
SILVER (Troy oz)	79d	—

	£ per ton	Weekly change £
ZINC, virgin, min. 98% purity (cash)	92½	—
,, (3 months)	89½	—
RUBBER, per lb. No. 1, R.S.S. spot	34½d	—
c.i.f. basis, ports, June	34½d	+½d
ARMOURING: Galv. Steel Wire (0·104 in.) ...	66½	—
Mild Steel Tape (0·04 × 1½ in.)	53*	—
NICKEL (home)	600	—
MERCURY (76 lb flask)	70½	—
AMERICAN PRICES: Copper, electrolytic (per lb) ...	33c	—
Lead (New York)	12c	—

* *Tape Price, now an average, includes varnishing*

Fife chooses floor-warming

THE sole means of space heating in Council-owned property in Fife is to be off-peak electric floor-warming in future, Fife County Council decided last week. Provision will be made in all new buildings for underfloor heating, and the possibility of changing over from oil heating in schemes already started is to be investigated. Also, the introduction of low pressure hot water heating by electricity in schemes in an advanced state of preparation is to be considered.

These decisions were the outcome of a recent meeting between the Convener's Committee, the National Coal Board, the Scottish Gas Board and the South of Scotland Electricity Board. The Coal Board gave an assurance that if the Council installed solid-fuel plant for heating, adequate supplies of solid fuel would be available at all times to meet reasonable anticipated requirements. The Electricity Board stated that they had no intention of introducing oil-burning plant for the production of electricity.

It was moved that the Council be recommended that space heating should be by electricity, but there would be no wholesale conversion or disturbance of existing arrangements and the possibility of using coal instead of electricity in particular cases would be kept in mind.

Those Rising Prices

INCREASES in the price of industrial coal, electricity, gas, fuel oil and steel between 1949 and 1959 were quoted by the Minister of Power in answer to a Parliamentary question last week. The percentage increases are: Nationalised industries—coal 81%; electricity 33%; gas 70%. Non-nationalised industries—fuel oil 27%; iron and steel 96%.

N.P.L's Autonomics Division

THE name of the Control Mechanisms and Electronics Division of the National Physics Laboratory is to be changed to the Autonomics Division.

The word "autonomics," meaning "self-governing," is considered to be particularly apt as a description of the new types of device that the Division aims to develop, in particular, machines operating on cybernetic principles capable of improving their own performance, with the faculties of recognition, translation and control. For this purpose, the new Division will work closely with biologists in studying the methods which living physical systems use to achieve control.

NATIONALISED INDUSTRY SPENDING

THE estimated capital expenditure and Exchequer borrowing needed to finance the nationalised industries over the next five years were quoted by the Chancellor in a written answer to a Parliamentary question last week. They are:

Industry	Period	Capital Expenditure £m	Exchequer Borrowing £m
Electricity Council ...	1959-65	2,130	1,150
N. of S. H-E B ...	1958-64	137	135
S. of S. EB	1958-64	165	105
Nat. Coal Board ...	1960-65	511	160
Gas Council	1960-66	370	123

News in Brief

The British Association of Corrosion Engineers has been elected a member of the European Federation of Corrosion.

Hatfield Technical College has been officially recognised for the conduct of courses leading to the Diploma in Technology. Courses so far approved are in electrical engineering and aeronautical engineering.

Electric under-floor heating will be provided in an 11-storey block of flats being built at Pennymead, Harlow New Town.

In the EIBA Golf Competition, 1960, the north western (Manchester) area qualifying competition will be held at Stockport (Torkington) Golf Club on 4 May.

The BBC's Orkney v.h.f. sound broadcasting station at Netherbutton, near Kirkwall, will be brought into full power service on 2 May.

Company Activities

SLOWLY, as the dust raised by the Budget settles, a dim picture emerges on the Stock Exchange and already it is clear that investors do not like the taste of Mr Amory's medicine. On the face of it the Government's idea of warning the economy rather than taking positive measures seems to have misfired. Investment sentiment has been upset far more by the implications of the Chancellor's dark threats than it might have been by a tougher fiscal policy. The initial effect of the prevailing apprehension has been to turn both the public and the institutions away from top-notch shares with their 3% yields and towards higher yielding equities and gilt-edged. Government stocks in particular have been popular on the idea that now the big banks are pulling in their horns they will not be such ready sellers of gilts. Their praises have also been sung by no less a personage than Mr W. S. Andrews, investment manager of the Unilever pension fund.

Against this unhelpful background electrical shares have been languishing, while the latest trade news from the cable industry is unlikely to stimulate buying interest. On the whole the larger cable companies are holding their own, but the basic problem of over-capacity remains and the smaller manufacturers are grimly hanging on in the hope of better times to come. The recent price increases were, of course, a step in the right direction, but many firms have yet to feel the full benefit of the new tariff.

No clear impression can be formed from financial results published by the cable companies, mainly because there have been so many amalgamations and take-overs in the industry that it is rare to find one trading year comparable to another. The recent profit figures of Enfield Rolling Mills for example included the earnings of Enfield Cables, which was acquired last June. A spokesman for the group, has, however, stated that Enfield Cables did not make a significant contribution to the overall performance, and one is left to conclude that the rest of the company has improved its position.

Unfortunately, any optimistic feelings created by Enfield Rolling are not supported by the experience of its bigger brother, British Insulated Callender's Cables, whose cable production probably accounts for between 40% and 45% of the total British market. Here again the acquisition of the Telegraph Construction and Maintenance Co. and Scottish Cables obscures the true nature of the year's events. Nevertheless it must be said that the smallish increase of just over £200,000 in the gross trading surplus is hardly inspiring in view of the substantial additions to the group. A comparison between group sales, which have increased by over 16% to £128 million, and the small 2·3% rise in the trading surplus to £9·01 million suggests that profit margins have again proved troublesome in the year under review. In this connection especially, it will be interesting to see what the chairman has to say about current conditions when the full report comes out.

BICC's net profits are more encouraging, having risen from £3·07 million to £3·53 million. This is due to two factors, namely a reduction of nearly £300,000 in the tax charge and an intriguing jump in investment income from £359,000 to £677,000. The accompanying figures of Telegraph Construction and Maintenance, one of the new subsidiaries, do not make such comforting reading. Net profits have slipped from £237,000 to £140,000 after deducting tax of £147,000 against £261,000. Since these bare figures call for comment much will depend on the remarks accompanying the published accounts. For the moment BICC are quoted at 57s 6d to yield 4·6% on the maintained 13½% dividend.—*From our City Correspondent.*

H. J. Baldwin and Co. Ltd.

During the current year there has been considerable expansion in the company's activities which has necessitated loans from Hartley Baird Ltd., the parent company, in excess of £100,000, the chairman, Mr H. J. D. L. Walmsley, states. Hartley Baird has agreed to the capitalisation of £95,556 18s of those loans by the issue of 955,569 Ordinary 2s shares. In addition, the directors propose to raise further capital by a rights issue to Ordinary shareholders, other than Hartley Baird, of 544,431 Ordinary 2s shares.

Birmingham Sound Reproducers

Although the group profit for 1959 dropped to £1,386,013 from the previous year's figure of £1,538,341, dividend is raised slightly. The final is of 35% making a total of 50% for the year—against the equivalent of 44½%.

British Electric Transformer Co.

A cash offer has been received from CP Properties (a wholly owned subsidiary of Crompton Parkinson) to purchase all the 5% Cumulative Preference shares of £1, at a price of 20s each. The BET directors recommend acceptance. Crompton Parkinson already hold the Ordinary capital.

British Insulated Callender's Cables Ltd.

Group sales for 1959 rose by £18 million to £128 million, but included figures for Telegraph Construction and Maintenance Co. and its subsidiaries for the whole year, and of Scottish Cables from 1 April, 1959. Trading profit, however, only increased from £8,808,610 to £9,011,003. After smaller taxation charge, net profit is £4,231,569 (*£3,292,989*). Total distribution is maintained at 13½% on the increased capital with a final dividend of 9½%.

Chloride Electrical Storage Co.

After taxation, net profit for 1959 increased to £1,473,287 from the previous year's total of £899,009. Dividend is effectively raised from the equivalent of 13½% to 17½% on the increased capital, with a final of 12½%.

Kango Electric Hammers

Net profit for 1959 is £46,064 (*£31,566*) after taxation charge of £38,589 (*£31,472*). Dividend is raised from the equivalent of 12½% to 15% with a final of 9%. In addition a Golden Jubilee bonus of 2½% is being paid.

Wm. Sanders and Co. (Wednesbury)

For 1959 the profit is £35,908 (*£31,393*) before taxation, and dividend is raised 5% to 25%.

Sangamo Weston Ltd.

The welcome increase in trading profit (by £40,216 to £422,451) was due primarily to a substantially increased turnover in house service meters and other principal products. Meter prices were, in fact, cut by 11½% a year ago and by a further 7·7% last October, but improved manufacturing techniques, with modernisation of plant, aided the improvement. Turnover during the current year has continued to expand, and the demand both at home and overseas for the company's products is encouraging, Sir Sam H. Brown, the chairman, reports. The price outlook is not, however, entirely clear, particularly for house service meters. Further rises in labour costs and general operating expenses have also to be met.

Telegraph Condenser Co. Ltd.

Last year's output and turnover represented an all-time record—group profit was 45% up—with practically the whole of the firm's plant and machinery operating to capacity. The factory in Scotland has continued to expand and export and overseas business was extremely satisfactory, with the exception of the Canadian subsidiary. Mr

Year to 31 Dec.	£ Trading Profit	£ Net Profit	% on Ord.		Ord. Price	
			Earned	Paid	High	Low
1955	611,637	264,591	76	25	54/6	41/-
1956	470,378	159,396	46	25	47/-	32/6
1957	434,696	131,257	38	25	42/6	35/-
1958	533,795	187,486	54	25	38/-	33/-
1959	772,268	319,353	87	35	59/6	38/-

D. W. Aldridge, the chairman, reports. Recently, there have been indications of some tightening of the Government's monetary policies and any accentuation of this could cause some setback of the company's expansion. But currently, the order book is satisfactory, business is brisk and, if the demand continues at the present level, the company should again have a satisfactory year.

COMMERCIAL INFORMATION

Contracts Open at Home . . .

Dates given are the final for receipt of tenders unless otherwise stated.

21 April—Burnham P.C. Supply, erection and commissioning of 33 Group "A" units on A4 Bath Rd. Council Clerk, 1 Evesham Rd, Iver, Bucks. Applications by above date.

21 April—Stoke-on-Trent T.C. Electrical installations (a) annexe Blurton Secondary School; (b) improvements at Lindsay Secondary School. Applications to City Architect, Kingsway by above date. Deposit £2 in notes each contract.

22 April—Ipswich C.B. Electrical installations in third instalment of Thurleston S.M.M. School. Applications to architects: Johns Slater and Haward, 32 Foundation St, Ipswich, by above date.

23 April—Bishop's Stortford U.D.C. Provision of tubular heating in Council Offices and underfloor heating, lighting and power installations in extension.—See 14 April issue.

25 April—Abertillery U.D.C. Supply and erection of (a) stage lighting equipment at Metropole Theatre.—See 14 April issue.

25 April—Manchester C.C. Supply and installation of passenger lift at Newall View Aged Persons' Home.—See 14 April issue.

25 April—Newmarket R.D.C. Supply and erection of vertical spindle sewage pumps in two stations for Burwell, contract includes motors, control gear, valves, piping and other ancillary gear.—See 7 April issue.

26 April—Bangor B.C. Provision of 62 single-arm concrete columns with three 80 W fluorescent units.—See 14 April issue.

26 April—Belfast. (c) Electrical installation in new voluntary primary school at Clady Corner.—See 7 April issue.

26 April—Port Talbot B.C. Street lighting conversion from gas in Velindre and Springfield areas, Aberavon. Borough Engineer's Dept., Municipal Bldgs.

26 April—Wilts C.C. (b) Installation of electrical systems in 110,000 sq ft new College of Further Education at Salisbury and in 23,500 sq ft Lavington new Secondary Modern School. Applications to County Architect, County Hall, Trowbridge, by above date.

27 April—Blackpool C.B. Supply of (a) Group "A" post-top fluorescent lanterns including control gear; (b) special cast iron spigots for post-top fluorescent lanterns.—Advertised 14 April issue.

27 April—Durham C.C. Electrical installations renewal at Shildon County and Modern Schools and electrical installation in Winston Stubb Hse Youth Holiday and Training Centre. Applications to County Architect, South St, Durham by above date.

27 April—Ealing B.C. Contract A—supply of 106 3 x 80 W fluorescent lanterns/lamps and 46 400 W MBF/U lanterns, lamps and control gear. Contract B—supply and erection of 150 25 ft steel columns.—Advertised 7 April issue.

27 April—Sutton Coldfield B.C. Supply and erection of sodium vapour lamps/lanterns and 30 ft steel columns on A453, Tamworth Rd.—See 7 April issue.

27 April—West Riding C.C. Applications for inclusion in list of approved contractors for work value (1) £1,500 to £5,000; and (2) £5,000 to £10,000.—See 14 April issue.

28 April—Isle of Axholme R.D.C. Supply and erection duplicate centrifugal unchokeable sewage pumps each of 120 g.p.m. and one of 50 g.p.m. sludge pumps.—See 7 April issue.

29 April—Armagh. Electrical installations in: (1) school: and (2) kitchen: on fixed-price basis in additions to Forkhill Voluntary Primary School. Details from architect, Liam P. Tierney, 3 Kildare St, Newry, N.I. Deposit £5 5s.

29 April—Helmsey R.D.C. Contract 2. Provision and erection of duplicate pumping plant each capable of handling 2,400 g.p.h. against a 330 ft head.—See 14 April issue.

29 April—Kilwinning T.C. Supply of 73 140 W lanterns for A78 lighting.—See 7 April issue.

29 April—Maidstone B.C. Electrical installations in 40 old people's bungalows, Scheme P.W.8 Park Wood Housing estate. Borough Engineer, Palace Ave.

29 April—Stourbridge B.C. Provision and installation of 441 Class "B" street lighting units.—See 14 April issue.

30 April—Dumbarton T.C. Applications for separate trade schedules for erection of 130 houses Leven/Clyde streets and 40 houses Townend Rd.—See 14 April issue.

30 April—Glantawe Hospital. Applications for inclusion in prescribed lists of contractors for (B) electrical supplies; (E7) electrical work, (E9) maintenance of refrigerators.—See 7 April issue.

2 May—Armagh. Electrical installation in new office building, Alexander Rd for M. of Finance. Room 103, Law Courts Bldg, Belfast.

2 May—Barking B.C. Supply and erection of 105 35 ft steel columns, lanterns and control equipment along A13. Borough Engineer and Surveyor, Town Hall. —Advertised in this issue.

2 May—Birmingham C.C. Electrical installations, as separate contracts, in tenants' rooms on following estate: Hillyfields, Pool Farm, Dawberry Rd and The Firs. Deposit £2 2s each contract payable to City Engineer and Surveyor, Sir Herbert J. Manzoni, Civic Centre, Birmingham 1.

2 May—Easington R.D.C. Supply of (item 4) electrical materials for period to 31 March, 1961. Council Clerk, T. Agar, Council offices.

2 May—Harrow B.C. Supply and installation of 1,150 60 W sodium and 50 2 x 40 W fluorescent lanterns, lamps and control gear. Borough Engineer, 48 Uxbridge Rd, Stanmore, Middx. Deposit £2.

2 May—Stockport T.C. Electrical installations in (Contract 48A) 76 dwellings and (Contract 48B) 67 dwellings at Brinnington.

2 May—Swinton and Pendlebury B.C. (1) Provision of 93 25 ft steel columns, bracket arms, 140 W sodium lanterns and control gear; (2) dismantling 32 existing m.v. units and erection and wiring of 93 columns and lanterns for E. Lancs Rd. Borough Engineer, Town Hall.

2 May—West Riding C.C. Rewiring work at: (contract 2) Castleford New Fryston J.M. and I. school; (contract 3) Conisbrough Denaby Main School; (contract 4) and fire alarm system at Spenborough Heaton Ave school; (contract 5) Southowram J.M. and I. school. Applications to: (contract 2) Divisional Architect, Bishopgarth, Westfield Rd, Wakefield; (contract 3) Divisional Architect, Planet Rd, Adwick-le-Street; (contracts 4 and 5) Divisional Architect, Flint St, Huddersfield by above date.

2 May—Willenhall U.D.C. Provision and fixing of Group "B" 80 W mercury discharge lighting and erection only of Stanton 9A concrete columns.—See 7 April issue.

3 May—Clydebank T.C. Supply of concrete columns, lanterns, auxiliary gear and o/h cable for A82 Gt. Western Rd lighting. Inspector of Lighting, James Craig, Melfort Ave

3 May—Enniskillen. Electrical installation, by registered contractors, in new voluntary school for boys, Derrin Rd.—See 31 March issue.

4 May—Bingley U.D.C. Supply (except columns) and erection of 113 Class "B" lighting units on various roads.—See 14 April issue.

4 May—Cardiff C.C. Supply of (1) concrete lighting columns; (2) lanterns, lamps and control gear; (3) solar time switches for year.—See 14 April issue.

4 May—Castle Ward R.D.C. Provision and erection 43 200 W linear sodium units on 35 ft steel columns on A1, North Gosforth. —See 14 April issue.

4 May—Wandsworth T.C. Supply and erection of 2,600 steel and concrete columns plus ancillary gear for sodium discharge lighting.—Advertised 7 April issue.

5 May—Coventry T.C. Supply of (8) lamps and accessories for year to 31 June, 1961. City Engineer, Council Hse.

5 May—Glasgow T.C. (2) Provision of a five-ton o/h crane for Davyhulme Sewage Works extensions.—See 31 March issue.

5 May—Omagh U.D.C. Rewiring in m.i.c.s. cables, supply of switchgear and lighting fittings in auditorium, stage and dressing rooms of Town Hall. Town Clerk, J. McGale. Deposit, £2 2s.

6 May—Dagenham B.C. Lighting and power installations in 102 dwellings, Limbourne Ave.—See 14 April issue.

6 May—Glasgow T.C. Electrical installations

Your Queries Answered

Readers are invited to make use of our free enquiry department which possesses wide resources, including an index of trade information with over 100,000 entries

A Selection from the 105 queries answered this week

"Suratel" suppressors — makers of? H.W.—Wolf Electric Tools Ltd., Pioneer Wks, Hanger La, Ealing, W.5.

"Expreso" switches — makers of? R.M.L.—Siemens Ediswan Ltd., 155 Charing Cross Rd, W.C.2.

"Toastmaster" toasters—agents for? R.M.—Frank V. Magrini Ltd., 24 Royal College St, N.W.1.

"Forfex" hair clippers—agents for? S.E.B.—John A. Fransen Ltd., 6 Ryefield Cres, Northwood Hills, Middx.

"Bico" washing machines — address for? T.E.—The Continental Washing Machine Co. Ltd., The Rolls-Electromatic Factory, 249-289 Cricklewood Broadway, N.W.2.

Solar batteries—makers of? W.J.—International Rectifier Co. (Great Britain) Ltd., Oxted, Surrey.

"Dandy Swiss" razors—agents for? R.C.S.—B. H. Ries Ltd., 19/21 Hatton Gdn, E.C.1.

"Ducal" fan heaters—makers of? E.E.W.—Ducal Appliances, Dalehall, Burslem, Stoke-on-Trent, Staffs.

P.M.D. Chemicals Ltd.—address for? V.A.—Hearsall La, Coventry, Warwicks.

in Bridgeton and Shettleston libraries.—See 7 April issue.

6 May—Kirkcaldy T.C. Supply of (a) electrical goods; (b) fittings; (c) lighting columns; (d) lamps; (e) cables on Lighting Dept, Schedule 2. Town Clerk, C. D. Chapman.

6 May—Longbenton U.D.C. Supply and erection of (a) 51 sodium vapour units on concrete columns along Gt. Lime Rd; (c) 53 sodium vapour units on either concrete columns or on existing Electricity Board poles. Engineer and Surveyor, A. E. Sweetman, Forest Hall, Newcastle upon Tyne 12. Deposit £2 2s.

9 May—Antrim. Electrical installations in: (1) school; and (2) servery; at new voluntary primary school for boys, Avenue Rd, Ballycastle. Details from consulting engineers, Varming and Mulcahy, 37 Malone Rd, Belfast. Deposit £5 5s.

18 May—Sligo Mental Hospital Board. Supply of electrical equipment: one 100 lb washing machine; one 8 cu ft hydro extractor; one 60 lb drying tumbler; one 300/32 lb ironing machine. Details from consulting engineer, Eoin Kenny, 44 Kildare St, Dublin C.17. Deposit £5 5s each specification.

23 May—Huddersfield C.B. Electrical installation including underfloor heating in two blocks of 11-storey flats, Northgate/Southgate. Borough Architect's Office, High St Bldgs.

No date stated—Liverpool. Applications invited for inclusion in approved list for engineers and electrical supplies. Group Secretary, Liverpool and District Eastern Hospital Management Committee, Broadgreen Hospital, Liverpool 14.

No date stated—Stanway P.C. Provision of 19 140 W Group "A" sodium lanterns on 25 ft concrete columns along A12. Council Clerk, H. C. Miller, 24 Villa Rd, Stanway, Colchester.—Advertised in this issue.

Gazette Announcements

BANKRUPTCY ACTS

First Meetings and Public Examinations

High Court of Justice. F. R. Shortland, electrical contractor, carrying on business as F. R. Shortland and Sons, at 52 Brook Dr, S.E.11. First meeting: 11 a.m., 22 April: and public examination: 11 a.m., 17 May, both at Bankruptcy Bldgs, Carey St, W.C.2.

Brighton. A. Lankester, building and electrical contractor, 65 St. Thomas's Rd, Worthing. First meeting: 11 a.m., 22 April, at Official Receiver's Office, 8 Old Steine, Brighton 1; and public examination: 10.30 a.m., 10 June, Court Hse, Church St, Brighton.

Receiving Order

Southend. K. G. Richards, dealer in domestic appliances, lately carrying on business at Warrior Hse, Warrior Sq, and with another as Southern Electrical Appliances, at 21 Redcliff Dr, Leigh-on-Sea. Receiving order dated 7 April.

Appointment of Trustees

Brighton. R. P. Greenslade, electrical distributor, carrying on business at 32 New Rd, Brighton. Mr J. S. Bradley-Hole, 7 Old Steine, Brighton, appointed trustee as from 1 April.

Hertford. R. A. Fawke, electrical retailer, lately carrying on business at 9 Market Hse, Town Centre, Harlow. Mr A. H. Milward, 6 Cavendish Court, 11/15 Wigmore St, W.1, appointed trustee as from 4 April.

Intended Dividend

Birmingham. H. Rose, electrical contractor and dealer, carrying on business as Rose Electrical Service, at 158 Soho Rd, Handsworth. Last day for receiving proofs for intended dividend: 23 April, to trustee: W. H. Haigh, Somerset Hse, 37 Temple St, Birmingham 2.

COMPANIES ACTS

Sefton Electrics Ltd. Mr R. P. Booth, 5 Rumford Pl, Liverpool 3, appointed liquidator at extraordinary general meeting on 5 April.

Faith Electrics Ltd. Mr M. R. Frankel, 13 Park Pl, S.W.1, appointed liquidator as from 4 April.

Rolfe and Oliver Ltd. Creditors to send details to liquidator: J. E. Ellis, 50 The Terrace, Torquay, by 31 May.

C.W. Radio Electric Ltd. Creditors to send details to liquidator: J. R. Norris, 14 Beverly Dr, Edgware, Middx, by 29 April.

Thomas Glover (Electrical) Ltd. Mr R. Piercy, 14 Harborne Rd, Edgbaston, Birmingham 15, appointed liquidator as from 4 April.

Falconar Cross and Co. Ltd. E. M. Robinson, 16 Market St, Newcastle-on-Tyne 1, appointed liquidator as from 4 April.

W.E.H. Electrics Ltd. Winding-up order dated 11 March.

. . . and Overseas

*Details of items marked * may be obtained on application to the Board of Trade, Lacon Hse, Theobalds Rd, W.C.1, quoting reference.*

24 April—Salvador. 39,000 bulbs, 115 V. La Proveeduria General de la Republica, Ave Espania 613, San Salvador. B.o.T. (ESB/10056/60).*

28 April—America. Seven items 115 kV equipment, including insulators, lightning arresters, disconnect switches and potential transformers. U.S. Army Engineer District, Bldg 602, City-County Airport, Walla Walla, Washington. B.o.T. (ESB/10078/60).*

2 May—Pakistan. One ton capacity furnaces, one for ferrous and one for non-ferrous metals. Wapda Electricity Dept., Gardee Trust Bldg, Lake Rd, Lahore. B.o.T. (ESB/9777/60).*

3 May—India. 71,400 yd 3 kV grade ·02624 sq in. single-core neoprene sheathed airport cable and connectors. Director-General, Civil Aviation, New Delhi. B.o.T. (ESB/9752/60).*

12 May—Nigeria. Two 5MVA 11/33 kV feeder transformers, one 750 kVA 11/6·6—3·3 kV station transformer and two 750 kVA 6·6—3·3 kV/415V auxiliary transformers. Electricity Corpn. of Nigeria, Adelphi (fourth floor), John Adam St, W.1. Fee £1, reference 1033/53.—Advertised in this issue.

16 May—Trinidad and Tobago E.C. Transformers, meters, metering equipment, h.s. distribution boards, underground cables and accessories. Purchasing Officer, P.O. Box 121, Port-of-Spain.—Advertised in this issue.

17 May—India. 11 kV and 440 V switchgear for Rihand Grid Substations. Superintending Engineer, Rihand H.E. Design Directorate, 10/489, Allenganj, Kanpur. B.o.T. (ESB/10103/60).*

2 June—India. 33 kV underground cables and 11 kV flexible cable couplers for Neyveli Lignite Corpn. (Private). India Store Dept., Bromyard Ave, W.3. B.o.T. (ESB/8763/60/ICA).*

TRADE MARKS

This information is extracted from the Official Journal by permission of the Controller.

Alux. 777,402. Class 6. Aluminium sheets with a highly polished surface for use in the manufacture of light and lamp reflectors. Veritys Ltd., Hazelwell Wks, Fordhouse La, Stirchley, Birmingham 30, and Westdeutsche Beleuchtungo-geselbschaft Schellenbach K.G., Klosterstrasse 118, Dusseldorf, Germany.

Carousel. 798,998. Class 7. Washing machines and drying machines. English Electric Co. Ltd., Queen's Hse, Kingsway, W.C.2.

Colt. 797,924. Class 9. Terminals. S. H. Collett Mnfg. Co. Ltd., 347/349 Goswell Rd, E.C.1.

Corning. 762,062. Class 11. Parts and fittings of glass for lighting installations and appliances. Corning Glass Wks, Walnut St, Corning, N.Y., U.S.A.

Elsie. 798,045. Class 9. Apparatus, etc. Grove Electronics Ltd., Alexandra Rd, Hounslow, Middx.

Gayday. B793,059. Class 7. Washing and drying machines, etc. B793,061. Class 11. Domestic appliances, etc. Zeta Domestics Ltd., 11 Albert Sq, Manchester 2.

Gaylux. 789,178. Class 11. Lamps, lampholders and lampshades. Linolite Ltd., The Mill Wks, Burnivale, Malmesbury, Wilts.

Gladiator. 780,653. Class 11. Fans, etc. Veritys Ltd., Hazelwell Wks, Fordhouse La, Stirchley, Birmingham 30.

K-Tran. 789,342. Class 9. Apparatus, etc. General Instrument Corpn., 65 Gouverneur St, Newark, New Jersey, U.S.A.

Liettron. 798,176. Class 9. Apparatus, etc. 798,177. Class 11. Installations for lighting, etc. Lightron Ltd., 305 St. Vincent St, Glasgow C.2.

Niphan. In design. 789,820. Class 9. Electrical goods, etc. Simmonds and Stokes (Niphan) Ltd., Victoria Hse, Southampton Row, W.C.1.

Novalux. 799,024. Class 9. Cathode ray tubes. A. C. Cossor Ltd., Cossor Hse, Highbury Gr, N.5.

Packard-Bell. B794,042. Class 9. Instruments, etc. Parkard-Bell Electronics Corpn., 12333 West Olypic Boulevard, Los Angeles 64, California, U.S.A.

Vee-Line. In design. B780,330. Class 11. Heating apparatus, etc. English Electric Co. Ltd., Queen's Hse, Kingsway, W.C.2.

TRADE NOTES

Service. The Birmingham office of the Anglo-Swiss Screw Co. Ltd. is now at Windsor Chambers, 367a Bearwood Rd, Smethwick 41 (telephone Bearwood 2799), under the control of Mr A. K. Hughes. These new premises are in addition to the existing office in Coventry.

Agency. Pantak Ltd., of Vale Rd, Windsor, Berks, have concluded an agreement with Sierex Ltd., of 241 Tottenham Court Rd, W.1, for the marketing and servicing of the Siemens 15 meV industrial betatron.

Beama Contract Price Adjustment Formulae. *For Electrical Machinery and Equipment.* For purposes of calculating variations in (*a*) "Rates of Pay"—the rate of pay for adult male labour at 15 April, 1960, shall be deemed to be 204s 6d (operated from 28 March); (*b*) "Cost of Material"—the index figure for materials used in the Electrical Machinery Industry at 15 April, 1960, is 116·4* (180·6*).

For Turbo-Generating and Allied Plant. For purposes of calculating variations in: (*a*) "Rates of Pay"—the rate of pay for adult male labour at 15 April, 1960, shall be deemed to be 204s 6d (operated from 28 March); (*b*) "Cost of Material"—the index figures at 15 April, 1960, are: Materials, 125·7* (188·9*). "Blast Furnaces and Iron and Steel Melting and Rolling (1948 S.I.C. ref. 40/41)," 188·3*. Other Steel Goods, excluding tubes (1958 S.I.C. ref. 311/2), 128·3*. The price of brass condenser tubes ¼ in. o/d 18 s.w.g. on 14 April, 1960, is 4s 2½d per lb. *Provisional figure.

The figures in parentheses shown above relate to the earliest list of wholesale price index numbers in which the year 1949 is taken as the base 100. For the other figures 1954=100.

BUSINESS PROSPECTS

Barmouth. W. Cowlin and Sons, Penarth Rd, Cardiff, contractors for Elephant Chemical Co. Ltd. factory extensions.

Basildon New Town. W. and C. French, Buckhurst, Essex, contractors for Acadex Engineer Co. extensions.

Bedford. £182,000 two-storey extension to General Hospital. N.W. Regional Hospital

Birmingham. Planned: £16,000 premises, Ephraim Phillips Ltd., 56 Bissell St; £16,000 premises, Artis, 51 Tower St; £10,000 communication row premises, Husband and Currel, 39 William St; £10,000 building, Rayham Contract Furnishers.—Prudential Assurance Co., Holborn Bars, E.C.1, propose shop/office block, Colmore Row. Own architect. **T.C.** Tender: 111 dwellings on three sites. Town Clerk.

Boston C.C. £10,541 Kitwood Girls' School gymnasium planned. County Architect. —Planned £116,948 Old Leake School. County Architect.

Bournemouth. Cummings and Morrish plan Wallisdown Rd factory, 102 Evering Ave, Parkstone.—R. Simms, 93 Southbourne Rd, architect for proposed £2 million hotel. —Mr H. G. Walker plans 10-storey Christchurch Rd office and accommodation block.

Cambridge. T. A. Bird and B. M. T. Tyler, 13 Welbeck St, W.1, architects for £45,000 Emmanuel College students' hostel.

Clare R.D.C. Tender: 16 houses, seven bungalows on four sites. Surveyor.

Cheltenham. Montal Watch Fittings propose extensions to Prestbury factory.

Chesterton. Jesshope Ltd., Orford St, Longport, Newcastle, plan £500,000 factory.

Cowley. Planned: £20,000 classroom extension, Lawrence Church School.

Cricklade and Wootton Bassett R.D.C. Tender: 10 houses, 28 bungalows on three sites. Clerk of the Council.

Dartford. Trollope and Colls, 1 Noble St, E.C.2, contractors for £80,000 Wellcome Chemical Co. extensions.

Devizes. Tender: Two-storey admin. unit, Roundway Hospital, for Management Committee. Secretary.

Durham C.C. Proposed rewiring Birtley Ravensworth Terrace School and renewing electrical installation at Chilton Infant School (£500); Stanhope County School (£600); Bishop Auckland Barrington School (£1,150); Felling Bill Quay School (£2,500); and Hunwick School (£3,000).

Edinburgh. Planned: 18-storey Govt. block/flats/shops, Leith St area.

Enfield. Planned: S. V. Carter, factory building; Enfield Rolling Mills Millmarsh La factory for aluminium strip casting; United Flexible Metallic Tubing Co. South St factory.

Ferryhill C.C. Grammar school plan. Architects: S. W. Milburn and Ptnrs, 9 Esplanade, Sunderland.

Gateshead. Gray and Ptnrs, 8 Portland Terr, Newcastle, architects for Bren Mnfg. Co. factory extensions, Team Valley Estate. —M. L. Kubit, 14 Meridian Way, Newcastle, architect for J. W. Capstaff transport depot. Team Valley Estate.

Glasgow. Keppie, Hunderson and Ptnrs, 21 Woodside Pl, C.3, architects, for new University block.—£500,000 maternity unit planned for Royal Samaritan Hospital.

Harefield. £69,760 old people's home, Knightscote Farm, planned.

Harrogate. S. Jackson and Son, Ocean Chmbrs, Piccadilly, Bradford 1, architects for Thrift Stores' Cambridge St super market.

Hartlepool B.C. Tender: Miers Ave community centre. Town Clerk.

Hull. Hull Gauge and Tool Co., Blundells Bldgs, Beverley Rd, plan Clarence St site development.

Ilford. Richard Costain, contractors for Plessey and Co. laboratory block.

Kilmarnock. A. Dunlop, 110 King St, architect for Ritchie's Paper Products extensions.

Kirk Sandall R.D.C. Houses for Pilkington Bros. planned. Surveyor.

Leeds. Tapp and Toothill, Bramley Printing Wks, plan £30,000 Swinnow Rd, Bramley, extensions.

Leicester T.C. Lee St multi-storey car park planned.

Liverpool. Planned: Fisher and Ludlow Ltd., 46 Baker St, W.1, Horn House La factory; Birds Eye Foods, Hesketh Hse, Portman Sq, W.1, Arc Rd 10-acre development; Central Electric and Heating Co., 10 Gale Rd, Kirkby Trading Estate, development of Gale Rd site.

London. F. Boreham, Son and Wallace, 4a Bloomsbury Sq, W.C.1, architects for proposed Olympic Gymnasium Co.'s Gt. Suffolk St, S.E.1, factory.—Patman and Fotheringham, 15 Islington Pk St, N.1, contractors for Smith's Meters' £45,000 Rowan Rd extensions.—S. W. Milburn and Ptnrs, 9 The Esplanade, Sunderland, architects for Geo. Angus and Co.'s Gray's Inn Rd, W.C.1, extensions.—Adams, Holden and Pearson, 38 Gordon Sq, W.C.1, architects for London University African and Oriental Studies building additions, Gower St.—Trehearne and Norman, Preston and Partners, 83 Kingsway, W.C.2, architects for 10-storey office block, London Rd, S.W.16.—Morrison, Rose and Ptnrs, 4 Wimpole St, W.1, architects for Hanover St office block.—A MacDonald, Adeline Hse, Bedford St, W.C.2, architect for £150,000 multi-storey Swears and Wells' Oxford St extensions.—S.W. Met. Regional Hospital Board plan £217,250 block at St. James's Hospital, Balham.—Adams, Holden and Pearson, 38 Gordon Sq, W.C.1, architects for £400,00 Univ. College Hospital Mortimer Market dental block.

Manchester. Clarendon Club, Mosley St, plan six-storey office/shop and club block.

Morden. A. Green, 5 Hyde Pk Gate, S.W.7, architect for E. Alec Colman £1 million shop/office block, opposite Morden Underground Station.

Newcastle. Lloyd and Son, Pickering Pl, St. James's St, S.W.1, architects for Barclays Bank proposed Northumberland St shop/offices.—T. B. Pearson and Son, Wincomblee Rd, plan new factory. Wimpey and Co., contractors for £1,358,715 blocks of flats, Pottery Bank area.

Newton Aycliffe. Development Corpn. plan 22 houses.

N. Riding C.C. propose extension of Filey Rd training college and Geo. Pindar School.—Methodist Homes for the Aged propose home on Northstead estate. Tender: stage 2, Coatham School, Redcar. Architect: D. C. Hall, 8 Masons Yd, Duke St, St. James's, S.W.1.

Nottingham. Corpn. plan £400,000 Regional College of Art extensions.

Nuneaton B.C. Tender: 136 Abbey St flats. Borough Surveyor.

Oldbury B.C. Tender: 78 four-storey dwellings. Devonport, Wood and Kendrick, architects.

Otley U.D.C. Tender: Single-storey canteen for M. of Pensions, 11 Bondgate. Surveyor.

Peterborough. Joint Education Board plan £67,617 Werrington Primary School. Board's Archtiect. Douglas Stephen and Ptnr, 30b Wimpole St, W.1, architects for £1 million Midgate shopping area development.

Portadown. M of Commerce propose 52,000 sq ft Carrickblacker advance factory.

Portsmouth. Die Casting Machine Tools, 152 Green La, N.13, plan £100,000 Eastern Rd factory.

Scarborough. E. Allen, 32 St. Nicholas St, architect for Scarborough and District Newspapers printing works additions, Aberdeen Walk. **T.C.** E. T. W. Dennis and Sons propose extension of Melrose St printing works.

Shildon U.D.C. Pomeroy Developments plan Church St Methodist Church conversion for shops/offices.

Slough B.C. Tender: Two-storey extension to town hall. Borough Engineer.

Southampton. Richard Shepperd, Robson and Ptnrs, 5 Southampton Pl, W.C.1, architects for £150,000 training college block.

Southend-on-Sea. T. Mann Ltd., Scarborough Dr, Leigh, contractors for South Essex Plating Electrical Co. factory.

S. Shields. Kitching and Co, 21 Albert Rd, Middlesbrough, architects for office/shop scheme. Alston Limestone Co., contractors for Tyne Chemical Co. River Dr factory extensions.

Staines. H. O. Luder, 79 Regency St, S.W.1, architect for 60 Laleham Rd, E. Alec Coleman flats.

Stockton-on-Tees R.D.C. 615-house layout plan, Rosendale Farm, by J. T. Bell and Son, Market St, Newcastle, approved.—C. M. Yuill, Villiers St, W Hartlepool seek Junction Fm land development permission.

Stourbridge B.C. Tender: 12 flats, 32 bungalows, Rufford Estate. Town Clerk.

Stretford. A.E.I. (Manchester) Trafford Pk, plan, two-storey office block and laboratories, Barton Dock Rd.—British Arkady Co. plan storage extensions and works at Skerton St and Galgate St.

Suffolk. Home Office propose £33,000 additions Hollesley Bay Colony. £143,750 Blundeston prison planned.

Sunderland. S. W. Milburn and Ptnrs, 9 Esplanade, architects for Sixty-Minute Cleaners' North Eastern Trading Estates Ltd. factory. Newrick and Blackbell, 58 John St, architects for Ericsson Telephone extensions—Alexander Rose propose West Sunniside workshop, at Boilermaker's Hall—Braithwaite and Jackman, 2 Saville Pl, Leeds, architects for British Home Stores, High St West branch alterations.—Stephenson, Gillis and Ptnrs., 2 Saville Chmbrs, Newcastle, architects for Jackson The Tailor factory. Proposed £16,800 street lighting project, Town End Farm estate. Borough Engineer.

Sussex. Basil Spence and Ptnrs, 1 Canonbury Pl, N.1, architects for £265,000 College house and £275,000 physics bldg, Stanmer Pk, proposed for Univ of Sussex.

Sutton. Lanchester and Lodge, 10 Woburn Sq, W.C.1, architects, £750,000 Marsden Hospital, stage one. Contractors, Tersons.

Swansea T.C. Tender: E.S.N. Clase School. Borough Architect.

Tadcaster. C.A.S., St. James' Hse, Kensington Sq, W.8, contractors for stage one Hammonds United Breweries extensions.

Tipton B.C. Tender: 52 Aston St dwellings. Town Clerk.

Tunbridge Wells. C. Burns and Guthrie, 11 Calverley Pk, architects for £40,000 girls' school.

Watford. Planned: Queen's Rd redevelopment for shops/flats by Surrey Land Developments Co.; Clarendon Rd office block for The Artizan Group, 1 Cromwell Rd, S.W.7.—Carl Fisher and Assoc., 56 Portland Pl, W.1, architects for 11 High St shops and offices, City House Properties. —Richardson, Son and Knowles, 127 High St, Rickmansworth, Herts, architects for British Advent Mission's Stanborough Park administrative building.

West Sussex C.C. Tender: Worthing fire station and stage 1 school at Yapton. County Architect.

Winchester. Trust Houses Ltd., Shorts Gdns, W.C.2, plan hotel on Cathedral carpark site.

Winsford. Wilmot Breeden, Eastern Wks, Camden St, Birmingham 1, propose Wharton factory.

Woodford. Watkins and Decker, 13 Gray's Inn Sq, W.C.1, quantity surveyors for Northern Assurance Co., High Rd offices.

Worcester Park. Thomas Mitchell, 20 Bedford Sq, W.C.1, architect for conversion of Central Rd Odeon to Express Dairy supermarket.

Worcester T.C. £22,948 Christopher Whitehead Boys' School extensions planned.

York. Ben Johnson and Co. plan Boroughbridge Rd printing works extensions. **T.C.** Tender: Crematorium, Bishopthorpe Rd. City Architect.

MEETINGS TO NOTE

THURSDAY, 21 APRIL

I.E.E. (S. Midland Centre). "The Jodrell Bank Radio Telescope," C. M. Kington. G.E.C. Ballroom, Telephone Wks, Stoke, Coventry, 7 p.m.

A.S.E.E. (Preston Branch). Social evening. R.A.F.A. Club, East View.

INSTITUTE OF PHYSICS (N.E. Branch). "The Jodrell Bank Telescope," H. A. Prime. Cleveland Scientific and Technical Institute, Middlesbrough. 6.30 p.m.

INSTITUTE OF PHYSICS (Midland Branch). A.G.M. The University, Birmingham. 5 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (Medical Electronics Group). "Electro-Physiology," Dr J. G. Nicholls. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6.30 p.m.

FRIDAY, 22 APRIL

I.E.E. (Education Discussion Circle). "Broadening University Courses." Savoy Pl. 6 p.m.

I.E.E. (Sheffield Sub-Centre). Dinner/dance at Victoria Hotel. 7.30 p.m.

I.E.E. (N. Staffs Sub-Centre). "The Application of Transistors to Line Communication Equipment," H. T. Prior, D. J. R. Chapman and A. A. M. Whitehead. Duncan Hall, Stone. 7 p.m.

INSTITUTE OF PHYSICS (Midland Branch). Annual dinner. Birmingham University Union. 7 p.m.

MONDAY, 25 APRIL

I.E.E. (S. Midland Electronics and Measurement Group). "The Challenge of the Propagation Medium to the Radio Engineer," G. Millington. James Watt Memorial Insitute, Birmingham. 6 p.m.

I.E.E. (London Graduate and Student Section). "Microwave Techniques," K. C. Kao. Savoy Pl. 6.30 p.m.

IPSWICH AND DISTRICT ELECTRICAL ASSOCIATION. "Application of Electronic Computers," P. Tainsh. Electric Hse, Ipswich. 7.15 p.m.

I.E.S. (Leicester Centre). A.G.M. Demonstration Theatre, E. Midlands E.B., Charles St. 7 p.m.

TUESDAY, 26 APRIL

I.E.E. (Measurement and Control Section). "An Experimental Transistor-controlled Component Selection and Testing Machine," T. C. Cardwell, J. R. Smith and G. H. King. Savoy Pl. 5.30 p.m.

I.E.E. (N. Midland Utilisation Group). "Silicone Electrical Insulation," J. H. Davis. Leeds and County Conservative Club, South Parade, Leeds 1. 6.30 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY (Control Section). A.G.M. and "Some Recent Advances in Industrial Electrical Control Techniques," T. E. Barany, Manson Hse, 26 Portland Pl, W.1. 7 p.m.

A.S.E.E. (E. Kent Branch). "Electricity in Agriculture," J. Cowan. County Hotel, Canterbury. 8 p.m.

A.S.E.E. (Oxford Branch). "Crime Prevention and Lighting." Employment Exchange, Oxford. 8 p.m.

WEDNESDAY, 27 APRIL

I.E.E. (Electronics and Communications Section). "Henri de France Colour Television System," R. Chaste and P. Cassagne. Savoy Pl. 5.30 p.m.

I.E.E. (Sheffield Sub-Centre). "The Protection of Electrical Systems," H. G. Bell. Royal Hotel, Cleethorpes Rd, Grimsby. 7 p.m.

I.E.E. (N.W. Graduate and Student Section). "Developments in Lighting," F. A. Benson. Engineer's Club, Albert Sq, Manchester. 7 p.m.

I.E.E. (S. Midland Graduate and Student Section). A.G.M. Birmingham College of Advanced Technology, Gosta Green.

INSTITUTE OF FUEL. Presidential address. Institution Civil Engineers, Gt. George St, S.W.1. 5.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS. "Electronics in Oceanography," M. J. Tucker. London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6.30 p.m.

FUEL EFFICIENCY AND POWER FOR INDUSTRY EXHIBITION at Olympia until 6 May.

THURSDAY, 28 APRIL

I.E.E. "Radar Observations of Birds and 'Angels'," E. Eastwood. Savoy Pl. 5.30 p.m.

I.E.E. (Bristol Graduate and Student Section). "Some Applications of Magnetic Recording," H. M. Harrison. Kenyon Rd School, Wells. 7 p.m.

INSTITUTE OF FUEL (E. Midland Section). A.G.M. and "Nuclear Power—The New Power Stations," G. T. Shepherd. Gas Showrooms Lecture Theatre, Nottingham. 6.15 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS. Discussion, "The Education and Training of the Professional Radio and Electronics Engineer." London School of Hygiene and Tropical Medicine, Keppel St, W.C.1. 6.30 p.m.

A.S.E.E. (S. London Branch). "Static Electricity in Industry," S. J. Emerson. Greyhound Hotel, High St, Croydon. 8 p.m.

FRIDAY, 29 APRIL

I.E.E. (S. Midland Centre). Discussion. "The Generalised Analysis of Electrical Machines," College of Technology, Gosta Green. 6 p.m.

I.E.E. (N.E. Graduate and Student Section). A.G.M. Grey Hall, Kings College, Newcastle. 6.30 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS (S. Midlands Section). "The Application of Semiconductor Devices in Power Supplies." D. D. Jones. N. Gloucestershire Technical College, Cheltenham. 7 p.m.

A.P.L.E. (S.W. Section). Visit to Hortsmann Gear Co. factory and introductory talk including reference to Production Planning and Work Study. Newbridge Rd, Bath. 2.15 p.m.

SATURDAY, 30 APRIL

I.E.E. (N. Midland Graduate and Student Section). A.G.M. Leeds. 2.30 p.m.

NEW COMPANIES

Extracted from the Register issued by Jordan and Sons Ltd., 116 Chancery La, W.C.2.

Geoff Allen (Mansfield) Ltd., 8 Belvedere St, Mansfield. To take over business of experimental, electrical and mechanical engineers and manufacturers of light industrial plant and tools carried on as "Geoff Allen and Co." at Mansfield, etc. Nom. cap.: £1,000. Dirs.: Geoffrey E. Tedcastle and Alan R. Doleman.

Birmingham Home and Office Telephone Co. Ltd., 176 Broad St, Birmingham 15. Nom. cap.: £100. Dirs.: Richard Schneider, Sally David Cramer and Peter Saloman.

Bradbury, Webb Ltd., 301 Brixton Rd, S.W.9. Structural, mechanical, electrical and general engineers, etc. Nom. cap.: £100. Dirs.: Stanley A. Bradbury, Ronald A. Webb and Wilfred J. Webb.

T. F. Browne Ltd., 16 High St, Stanion, Northants. To take over business of an electrical engineer and contractor carried on at Stanion, Kettering, by T. F. Browne, etc. Nom. cap.: £1,000. Dirs.: Thomas F. Browne and Mrs P. Browne.

C.G.S. Resistance Co. Ltd., 30 Clarendon Rd, Harrow, Middx. Manufacturers of and dealers in electrical components, etc. Nom. cap.: £100. Dirs.: Vincent S. Chadderton and Mrs Mary Chadderton.

Consultair Ltd., 2 Compton Rd, Wolverhampton. Design, manufacture, sales and service of pneumatic, hydro and electro-pneumatics, etc. Nom. cap.: £1,000. Dirs.: to be appointed by subscribers. Subs.: D. Bayliss and J. M. Grosvenor.

Electric Utilities Ltd. Manufacturers of and dealers in sound and vision reproducing machines, etc. Nom. cap.: £100. Dirs.: to be appointed by subs. Subs.: Harry E. Golding, 3 Radnor Way, Langley, Slough, Bucks; and Robert C. Ellis, 14 Tudor Close, Eastcote, Pinner, Middx.

ERO Capacitors Ltd., 167-70 Ravenscroft Arches, W.6. Manufacturers of and dealers in wireless components and apparatus, etc. Nom. cap.: £15,000. Dirs.: William M. Hewett and William H. Alderson.

John Finnigan and Co. Ltd., 45 Beresford Rd, Manchester 13. To carry on business of plumbers and electricians, etc. Nom. cap.: £1,000. Dirs.: John J. Finnigan, John Finnigan and Catherine Finnigan.

E. L. Firby Ltd., 511 Garratt La, S.W.18. To carry on business of maintaining and repairing electric motors: electrical engineers, etc. Nom. cap.: £2,000. Dirs.: Edward L. Firby and Doris Firby.

General Electronic Services (Southend) Ltd., St. Andrews Wks, Richmond Ave, Shoeburyness, Essex. Nom. cap.: £500. Dirs.: Leslie W. J. Dowie and Mrs Joan Dowie.

Herman Smith (Contracts and Export) Ltd., Taywil Wks, Accrington, Lancs. Distributors and merchants of and dealers in electrical supplies, oil heaters, etc. Nom. cap.: £1,000. Dirs.: Herman G. Smith, Michael Herman Smith and Frank Duerden.

F. T. Holdcroft Ltd. To take over business of electrical engineers and contractors carried on at Hanley, Stoke-on-Trent, by F. T. Holdcroft, etc. Nom. cap.: £5,000. Dirs.: not named. Subs.: Fredk. T. Holdcroft and Mrs M. Holdcroft, Isleworth, Hilderstone Rd, Meir Heath, Stoke-on-Trent.

Robert Myers and Co. Ltd., Lloyds Bank Chmbrs, Lansdowne, Bournemouth. To carry on business of electrical, mechanical, radio, gas, sanitary and general engineers, etc. Nom. cap.: £1,000. Dirs.: Robt. Myers and Louis Black.

Rotaflex (Iran) Ltd. Manufacturers of and dealers in plastics, and in particular to handle Rotaflex products in Iran, etc. Nom. cap.: £100. Dirs.: Bernard Stern and John D. Vanstone. Subs.: Jean Herbert and Thos. A. Herbert, 156 Strand, W.C.2.

CONTRACTS PLACED

Admiralty. Navy Wks, value over £1,000, electrical installation, Kent establishment, South Eastern E.B.

Bolton T.C. Electrical installation, Wellington Yard Main Garage, D. V. Birch.

Burnley T.C. Installations at "Fir Grove" hostel: electrical, Robinson and Lawler, £1,999; lift, Electro Lifts Ltd., £1,742. Recommended.

Dewsbury C.B. Supply of steel columns for year, Abacus Eng. Ltd.

Down C.C. Installations at Kilwarlin Hse Old People's Home, Hillsborough; electrical Adair and Millikin, £1,550; lift, Adair Bros., £2,323.

Durham C.C. Electrical work in schools: Hebburn R.C. Aided, C.W.S. Ltd., £1,070; Spennymoor Mount Pleasant, Armstrong Electrical Contractors, £869; Wheatley Hill County, R. Robson, £1,416; Durham Technical College, North of England Eng. and Electrical Co., £3,159; Pelton Modern, T. Nicholson, £1,401; Hebburn Technical College, North of England Eng. and Electrical Co., £2,968. Recommended.

Hull T.C. Electrical installations: 92 dwellings north of Boothferry Rd, J. B. Kilvington Ltd.; 26 dwellings, Springhead Ave, Reliance Electrical Co.

Loughborough B.C. Electrical installations in 33 dwellings, Beacon Rd, J. H. Hickling Ltd., £1,546.

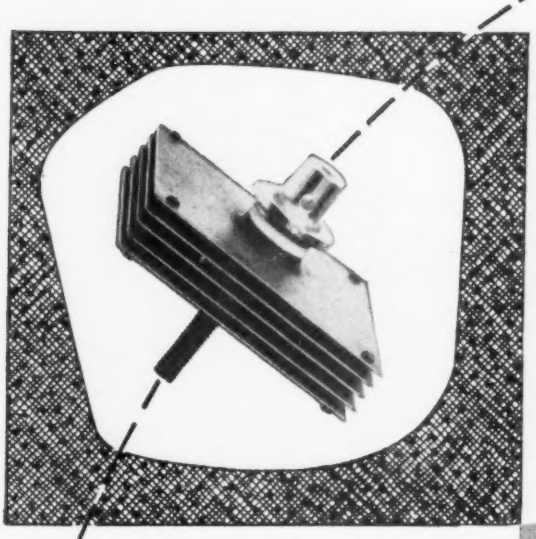
Notts C.C. Supply and erection 400 W mercury lanterns on steel columns at traffic island north of Blyth on A1, Abacus Eng. Ltd.

Swindon T.C. Rewiring and improvements at Even Swindon Schools, Ferris Bros., £1,056. Recommended.

Torquay. Electrical installation, Oddicombe Beach Redevelopment Cafe, Allwood and Langler Ltd., £884.

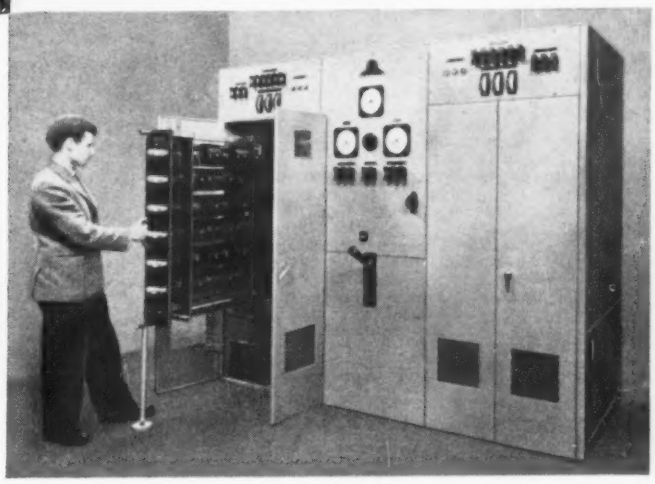
Greater Efficiency

at lower D.C. voltages



with HEWITTIC GERMANIUM RECTIFIERS

EMPLOYING HEWITTIC DIODES



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Send for Publication R.193.

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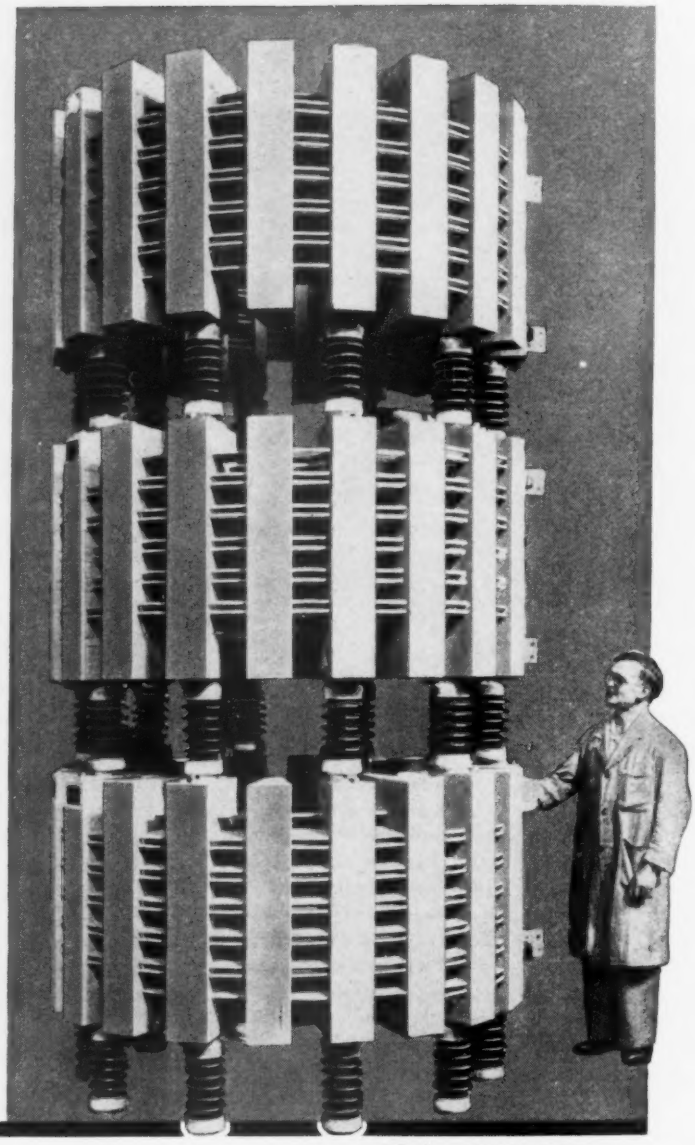
OVERSEAS REPRESENTATIVES: ARGENTINA: H. R. Roberts & Cia., S.R.L. Buenos Aires. **AUSTRALIA:** Hackbridge and Hewittic Electric Co. Ltd., 171 Fitzroy Street, St. Kilda, Victoria; N.S.W.: Queensland: W. Australia: Elder, Smith & Co. Ltd.; South Australia: Parsons & Robertson Ltd.; Tasmania: H. M. Bamford & Sons (Pty.) Ltd., Hobart. **BELGIUM & LUXEMBOURG:** Pierre Pollie, Brussels, 3. **BRAZIL:** Oscar G. Mors, Sao Paulo. **BURMA:** Neonlite Manufacturing & Trading Co. Ltd., Rangoon. **CANADA:** Hackbridge and Hewittic Electric Co. of Canada Ltd., Montreal; The Northern Electric Co. Ltd., Montreal, etc. **CEYLON:** Envee Ess Ltd., Colombo. **CHILE:** Sociedad Importadora del Pacifico Ltda., Santiago. **EAST AFRICA:** G. A. Neumann Ltd., Nairobi. **EGYPT:** Giacomo Cohenca Fils, S.A.E., Cairo. **FINLAND:** Sähkö-ja Konellike O.Y. Hermes, Helsinki. **GHANA, NIGERIA & SIERRA LEONE:** Glyndova Ltd. **GREECE:** Charilaos C. Coroneos, Athens. **INDIA:** Steam & Mining Equipment (India) Private Ltd., Calcutta; Easun Engineering Co. Ltd., Madras, 1. **IRAQ:** J. P. Bahoshy Bros., Baghdad. **MALAYA, SINGAPORE & BORNEO:** Harper, Gilfillan & Co. Ltd., Kuala Lumpur. **NETHERLANDS:** J. Kater, E.O., Ouderkerk a.d. Amstel. **NEW ZEALAND:** Richardson, McCabe & Co. Ltd., Wellington, etc. **PAKISTAN:** The Karachi Radio Co., Karachi, 3. **SOUTH AFRICA:** Arthur Trevor Williams (Pty.) Ltd., Johannesburg, etc. **CENTRAL AFRICAN FEDERATION:** Arthur Trevor Williams (Pty.) Ltd., Salisbury. **THAILAND:** Vichien Phanich Co. Ltd., Bangkok. **TRINIDAD & TOBAGO:** Thomas Peake & Co., Port of Spain. **TURKEY:** Dr. H. Salim Oker, Ankara. **U.S.A.:** Hackbridge and Hewittic Electric Co. Ltd., P.O. Box 234, Pittsburgh 30, Pennsylvania. **VENEZUELA:** Oficina de Ingenieria Sociedad Anonima, Caracas.

AEI

CAST-IN-CONCRETE CURRENT LIMITING REACTORS

The following outstanding features have contributed to the success of AEI CAST-IN-CONCRETE Reactors during the past 43 years



A 3 phase 10500 volt 2000 amp. reactor weighing 6½ tons.

- Fireproof
- Mechanically strong
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- Adaptable to most station layouts
- Concrete subjected in service to compressive stress only
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- High short time overload capacity
- High grade porcelain insulators provide the insulation to earth

For further details write to AEI Transformer Division, Rugby, Warwickshire, or your local AEI office

Associated Electrical Industries Limited
TRANSFORMER DIVISION
Manchester 23 and Rugby

E/A90*

CLASSIFIED ADVERTISEMENTS

TENDERS INVITED

ELECTRICITY CORPORATION OF NIGERIA

Transformers

Tenders are invited for the supply and delivery C.I.F. Apapa Wharf, Lagos, Nigeria, of:

2—5 MVA 11/33 kV Feeder Transformers.

1—750 kVA 11/6·6-3·3 kV Station Transformer.

2—750 kVA 6·6-3·3 V Auxiliary Transformers.

Tender documents may be obtained from:

The Electricity Corporation of Nigeria,
Adelphi (4th Floor),
John Adam St,
London W.C.2,

on payment of £1 quoting reference 1033/53.

Closing date 12 May, 1960. (P 686)

BOROUGH OF BARKING

Street Lighting - Trunk Road A.13

TENDERS are invited for the supply and erection of 105 35 ft steel columns together with lanterns and control equipment.

Forms of tender, specifications and bills of quantities may be obtained from the Borough Engineer and Surveyor, Town Hall, Barking.

Tenders must be returned in the sealed enveloped provided to the undersigned not later than 9 a.m., 2 May, 1960.

E. R. FARR,
Town Clerk.

Town Hall,
Barking. (P 665)

TENDERS

Tenders are invited for the supply of all or any of the following items of equipment:

Transformers
Meters
Metering Equipment
House Service Distribution Boards
Underground Cables and Accessories

Specifications may be obtained on writing to the Purchasing Officer, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, W.I. Closing date for Tenders: 16 May, 1960.

(P 664)

APPOINTMENTS VACANT

SOUTHERN ELECTRICITY BOARD

ASSISTANT ENGINEER
(MAINTENANCE AND OPERATION)

ISLE OF WIGHT District of No. 3 (Portsmouth) Sub-Area. Salary: N.J.B. Class F, Grade 9 (£815 x £15—£860 per annum). N.J.B. Conditions of Service.

The duties of the post will be to assist with the maintenance and operation of H.V. and L.V. distribution mains and substations and with minor construction work. A technical training to H.N.C. standard and experience of similar work are required.

Applications on forms obtainable from the Sub-Area Secretary, Lower Drayton La, Cosham, Portsmouth, and returned to him, quoting Z.1175, not later than 2 May, 1960.

GENERAL ASSISTANT ENGINEER

Reading District of No. 2 (Newbury) Sub-Area. Salary: N.J.B. Class J, Grade 16 (£610 x £15—£655 per annum, thence to £700 maximum of Grade 15). N.J.B. Conditions of Service.

The duties of the post will be to assist with distribution including minor construction work and general maintenance of H.V. and L.V. overhead and underground distribution systems, substation plant, etc. Applicants should possess suitable technical qualifications.

Applications on forms obtainable from the Sub-Area Secretary, 7 Oxford Rd, Newbury, Berks, and returned to him, quoting Z.1188, not later than 2 May, 1960.

The successful candidates for the above appointments will be required to contribute to the Electricity Supply (Staff) Superannuation Scheme, if eligible. (P 675)

CENTRAL ELECTRICITY GENERATING BOARD

East Midlands Division

APPLICATIONS are invited for the following positions within the Division:

STATION SHIFT CONTROL ENGINEER

HIGH MARNHAM POWER STATION

VACANCY No. 83/60.

Applicants should have had a sound technical training and practical experience in a modern power station. Preference will be given to applicants who possess the Higher National Certificate or its equivalent.

The salary will be in accordance with Class L, Grade 10 (£1,025—£1,085 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 29 April, 1960.

ASSISTANT ENGINEER (INSTRUMENTS)
DRAKELOW "A" AND "B" POWER STATIONS

VACANCY No. 88/60.

The selected candidate will be required to assist the Instrument Engineer in the maintenance, calibration and testing of modern power station instruments and controls.

Applicants should have sound technical qualifications and training, a knowledge of electronics and manufacturing experience would be an advantage.

continued in next column

continued from previous column

The salary will be in accordance with Class M, Grade 10 (£1,095/£1,170 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 29 April, 1960.

FOURTH ASSISTANT ENGINEER
COVENTRY SECTION

VACANCY No. 8760.

Applicants should have experience of maintenance and operation of E.H.T. overhead lines, transformers and switchgear.

Preference will be given to candidates with qualifications leading to Corporate Membership of the Institution of Electrical Engineers.

Salary will be in accordance with Class AX/EX, Grade 8 (£735/£960 per annum) of the National Joint Board Agreement.

Closing date for receipt of applications: 29 April, 1960.

STATION SHIFT CONTROL ENGINEER
DERBY POWER STATION

VACANCY No. 89/60.

Applicants should have had a sound training and practical experience in a modern power station. The possession of a Higher National Certificate in Electrical Engineering, or its equivalent, would be an advantage.

Salary will be in accordance with Class F, Grade 10 (£765/£810 per annum) of the National Joint Board Agreement, plus £90 per annum shift allowance.

Closing date for receipt of applications: 29 April, 1960.

ASSISTANT SHIFT CHARGE ENGINEER
CASTLE DONINGTON POWER STATION

VACANCY No. 90/60.

Applicants should have received a sound technical training and have had experience in a modern power station. Preference will be given to candidates who possess the Higher National Certificate or its equivalent.

Salary will be in accordance with Class L, Grade 8 (£1,195/£1,270 per annum) of the National Joint Board Agreement, plus 10% allowance for shift duties.

Closing date for receipt of applications: 29 April, 1960.

These appointments will be pensionable within the terms and conditions of the Electricity Supply (Staff) Superannuation Scheme.

Applications should be submitted on the official form AE6/ACT which may be obtained from the Divisional Establishments Officer, Central Electricity Generating Board, East Midlands Division, P.O. Box 25, Barker Gate, Nottingham, and should be returned to the undersigned by the date stated.

O. S. WOODS,
Divisional Controller.
(P 676)

BRITISH STANDARDS INSTITUTION

Technical Staff

THE B.S.I. invites applications from ELECTRICAL ENGINEERS or PHYSICISTS, with an Electrical or Telecommunication background, to join the technical staff of the Institution. This staff is responsible for the work of the Institution in the preparation of British Standards in co-operation with the various sections of industry, and is required to plan and progress the work. They act as secretaries to technical committees.

Applicants should have a university degree or equivalent professional qualification in electrical engineering or physics.

There are three grades of appointment and salaries in the top grade range up to £2,000 plus; applications are invited for the grade which has at present a maximum salary of £1,250, the starting salary being dependent on individual qualifications and experience. The posts are pensionable.

Apply to the Establishment Officer, B.S.I., 2 Park St, London W.1. (P 667)

Advertisements should be sent to the Classified Advertisement Dept., Electrical Times, Sardinia House, Sardinia Street, London, W.C.2, before 10 a.m. on TUESDAY of the week of issue. Official Displayed Advertisements are charged at 40s. per inch, and all other classified advertisements at 3s. per line. Situations Wanted four insertions at twice the single insertion rate. Fee for Box Number and postage on replies 2s.

ELECTRICITY AUTHORITY OF CYPRUS

APPLICATIONS are invited for the following posts. Appointment on temporary contract terms for two tours each of two years' residential service. Consideration given in certain circumstances to secondment from Home Area Board. Salary scales shown below include bonus and overseas and temporary allowances. Gratuity at the rate of 12½% of aggregate basic salary drawn during service (including approved leave). Outfit and settling-in allowance £35 (£75 if accompanied by wife). Free passages and furnished quarters. Liberal leave on full salary.

SENIOR ASSISTANT
DEKHELIA POWER STATION
(M2A/42690/EE)

Candidates should have had extensive experience of Public Electricity Undertakings with particular respect to the operation and maintenance of steam powered station plant and associated equipment including 66 kV substations.

SENIOR ENGINEER, PLANNING
(M2A/50449/EE)

Candidates must have good technical qualifications, be able to undertake E.H.V. system calculations, do studies to determine standards for distribution and substations and preferably have some general experience in the electrical industry including operation and maintenance.

Salary scale for above posts £2,588 rising to £2,744 a year.

Candidates should be A.M.I.E.E. or A.M.I.(Mech.)E., or equivalent.

ENGINEER, GRADE I, CONSTRUCTION
(M2A/50450/EE)

Candidates must have a sound training and experience of construction of substations, overhead lines and underground cables, up to 66 kV.

ENGINEER, GRADE I, GENERATION
(M2A/50451/EE)

Candidates must have had considerable experience of operation and maintenance of steam power stations and be able to undertake calculations, especially relating to the efficient operation of plant.

Salary scale for above posts £2,352 rising to £2,588 a year.

Candidates should be A.M.I.E.E. or A.M.I.(Mech.)E., or equivalent.

ENGINEERS, GRADE II
(VARIOUS CATEGORIES SHOWN BELOW)

Salary scale £2,039 rising to £2,352 a year.

Candidates should be Grad. I.E.E. or Grad. I.(Mech.)E., or equivalent.

ASSISTANT GENERATION ENGINEER
(M2A/50453/EE)

Qualifications and duties as for Engineer, Grade I (Generation), but of less senior status.

ASSISTANT COMMERCIAL ENGINEER
(M2A/50456/EE)

Candidates must have had thorough technical training and experience of commercial and development work in the electricity supply industry. They must be competent to assist with training, organisation and control of commercial staff and functions throughout an undertaking, to advise consumers on electricity utilisation, tariffs, terms, apparatus, etc., and to undertake routine testing and repair of domestic appliances, including demonstrations and exhibitions and control of workshops and service centres.

ASSISTANT OPERATION AND MAINTENANCE ENGINEERS
(M2A/50454/EE)

Candidates must have considerable general experience of public electricity supply over a large area and be capable of taking charge of the operation and maintenance of 66 and 11 kV transmission lines, switching stations and substations, E.H.V. and H.V. systems and their protection.

Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, qualifications and experience, and quote reference number shown against post applied for. (P 661)

BRISTOL COLLEGE OF SCIENCE AND TECHNOLOGY

College of Advanced Technology

THE Governors invite applications for following posts in DEPARTMENT OF ELECTRICAL ENGINEERING. Appointments to become effective on 1 Sept., 1960, or as soon as possible thereafter.

SENIOR LECTURER

To teach to Dip. Tech. and post graduate levels. Candidates must hold appropriate academic and professional qualifications and should have had teaching, industrial and/or research experience, preferably in fields of microwaves and microwave electronics.

LECTURERS (FOUR POSTS)

To teach in courses leading to Dip. Tech., I.E.E., Part III, Higher National Diploma and Higher National Certificate. Candidates must hold appropriate academic and/or professional qualifications and have had teaching, industrial and/or research experience and be prepared to teach in one of following fields:

Electronics, Electrical Power (Supply or Utilisation), Control Systems.

Salaries: Burnham Technical Report, 1959: Senior Lecturer: £1,550 x £50—£1,750. Lecturer: £1,370 x £35(4) and £40—£1,550.

Appropriate experience will be taken into account in fixing initial salary.

Application forms, returnable within two weeks of date of this advertisement, and details from Registrar, College of Science and Technology, Ashley Down, Bristol 7. (P 657)

ESSEX

Mid-Essex Technical College and School of Art

Market Road, Chelmsford

REQUIRED September, 1960:

(1) PRINCIPAL LECTURER (NEW POST) in ELECTRICAL ENGINEERING to teach I.E.E. Part III and H.N.D. Sandwich Courses, and to assist in departmental administration. Degree, corporate membership, teaching and industrial experience required. Subjects: Advanced Electrical Engineering, Electrical Measurements and/or Circuit Theory, Electronics, Control Systems.

Salary: Principal Lecturer, £1,750 x £50—£1,900 p.a.

Details and forms (stamped addressed foolscap envelope) from the Clerk to the Governors. (P 658)

AIR MINISTRY

REQUIRE ASSISTANT MECHANICAL and ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1,095 at 34 or over, thereafter rising to max. £1,260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. Five-day week with four weeks two days leave a year initially. Special allowance in addition to salary during overseas service. Quals. and experience:

(i) (a) University degree or equiv. diploma in electrical and/or mechanical engineering with at least two years' apprenticeship; or

(b) Graduate or corporate member of I.E.E. with at least three years' apprenticeship; or

(c) Graduate or corporate member of I.Mech.E., appreciable electrical engineering experience with at least three years' apprenticeship; and

(ii) Have been employed for minimum of two years with well-established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45. Forms from Ministry of Labour, Technical and Scientific Register (K), 26 King St, London S.W.1. quoting D.158/OA. (P 321)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

APPLICATIONS are invited for the following superannuable N.J.B. appointments:

LLYNFI POWER STATION
SHIFT CHARGE ENGINEER
Vacancy No.: 99/ET/60.

Salary: G.7, £965/£1,025 per annum.

Applicants should possess H.N.C. or equivalent qualifications, and have had experience in a modern Power Station.

TIR JOHN POWER STATION
MAINTENANCE ENGINEER (PLANNING)
Vacancy No.: 100/ET/60.

Salary: H.7 £1,025/£1,085 per annum.

Applicants should possess H.N.C. or equivalent qualifications and have had experience in a modern Power Station.

Special application forms obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 3 May, 1960. (P 673)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Lanarkshire Area

APPLICATIONS are invited to fill the undernoted vacancy:

FOURTH ASSISTANT ENGINEER
AREA PLANNING AND DEVELOPMENT DEPARTMENT

Applicants should have had a sound engineering training and should be familiar with load flow diagrams and voltage drop calculations.

The present salary scale is Class L, Grade 13, £860/£905 per annum.

The appointment is superannuable and the conditions of employment will be in accordance with the National Joint Board Agreement, Schedule A. The successful candidate will require to reside within a reasonable distance of the Area Offices at Hamilton.

Application forms, which may be obtained from the undersigned, should be forwarded to this Office within 14 days of the date of this advertisement.

R. J. RENNIE.
Manager.

Montrose Cres,
Hamilton. (P 663)

CENTRAL ELECTRICITY GENERATING BOARD

South Wales Division

APPLICATIONS invited for the following superannuable N.J.B. appointments:

Vacancy No. 92/ET/60.
ASSISTANT MAINTENANCE ENGINEER (MECHANICAL)
NEWPORT POWER STATION

Salary: F.8, £860/£905 per annum.

H.N.C. or equivalent qualifications and experience in power station mechanical maintenance desirable.

Vacancy No. 93/ET/60.
ASSISTANT MAINTENANCE ENGINEER (MECHANICAL)
TIR JOHN POWER STATION, SWANSEA

Salary: H.9, £910/£955 per annum.

Applicants should have experience in the maintenance of heavy plant and possess H.N.C. or equivalent qualifications.

Vacancy No. 96/ET/60.
STATION SHIFT CONTROL ENGINEER
TIR JOHN POWER STATION, SWANSEA

Salary: H.10, £860/£905 per annum.

Applicants should possess H.N.C. or equivalent.

Special application forms obtainable from Secretary, South Wales Division, Central Electricity Generating Board, Twyn-y-fedwen Rd, Gabalfa, Cardiff, to be returned by 3 May, 1960. (P 654)

Box No. replies to be addressed to the ELECTRICAL TIMES, Sardinia House, Sardinia Street, London, W.C.2

EASTERN ELECTRICITY BOARD

APPLICATIONS are invited for the following appointments. The successful candidates will be required to contribute to a superannuation scheme and may be required to undergo a medical examination.

Chilterns Sub-Area

SUB-AREA HEADQUARTERS, BEDFORD
ENGINEERING DRAUGHTSMAN
79/80.R.

Candidates should have had a good general and technical education and should preferably be experienced in substation design, layout of equipment and the preparation of plans and detailed drawings of buildings and civil engineering works.

Salary: N.J.B. Schedule D, Grade 6 (£620/£740).

Apply by letter to the Acting Manager, Chilterns Sub-Area, Eastern Electricity Board, Prebend St, Bedford, by 6 May, 1960.

Essex Sub-Area

SOUTH WEST ESSEX DISTRICT
DEMONSTRATOR
80/60.R.

Candidates should have had domestic science training, including electrical housecraft, should preferably hold the E.A.W. Certificate and be competent to plan and give cookery demonstrations, including lectures, and advise consumers on the use of domestic electrical appliances.

Salary: N.J.C. Grade 1 (£525/£625), plus London Allowance, although progress beyond £565 will be subject to a certificate that the person concerned is capable of undertaking all the duties of the grade.

Apply by letter to W. T. Langfield, A.M.C.T., A.M.I.E.E., A.I.MECH.E., Manager, South West Essex District, Eastern Electricity Board, Ashton Rd, Harold Hill, Nr Romford, Essex, by 6 May, 1960.

Northmet Sub-Area

SUB-AREA HEADQUARTERS, SOUTHGATE, N.14
THIRD ASSISTANT ENGINEER
(SYSTEM CONTROL) (Ref. 907)
81/60.R.

This appointment offers an excellent opportunity to a resourceful, self-reliant Engineer, for obtaining experience in the control of an extensive heavily loaded H.V. distribution system.

Candidates should be suitably qualified and experienced in the operation and maintenance of plant and equipment and have a sound knowledge of system protection.

A new Control Room, in the course of construction, will provide excellent working conditions.

Previous applicants need not re-apply as their applications will be considered, together with those resulting from this advertisement.

Salary: N.J.B. Grade 10 (£1,364 10s/£1,447).

Inclusive of Shift Allowance and London Allowance.

Apply by letter to the Manager, Northmet Sub-Area, Eastern Electricity Board, Northmet House, Southgate, London, N.14, by 2 May, 1960. (P 672)

ADEN GOVERNMENT

ASSISTANT CONSUMERS ENGINEER

REQUIRED on contract for one tour of 18/24 months in first instance. Salary according to age and experience in scale (including Pay Differential) £1,040 rising to £1,579 a year. Gratuity at rate of 12½% total salary drawn. Outfit allowance £60. Free passages. Candidates, preferably under 45 years of age, should possess H.N.C. in Electrical Engineering and have technical training and experience in utilisation of electrical energy in industrial, commercial and domestic premises, knowledge of installation work and be conversant with tariffs sales and all aspects of consumer service. Write to the Crown Agents, 4 Millbank, London S.W.1, State age, name in block letters, qualifications and experience and quote M2A/51004/EE. (P 656)

CENTRAL ELECTRICITY GENERATING BOARD

South Eastern Division

ELECTRICAL DEPARTMENT
CANTERBURY DISTRICT
Vacancy No. 86/60.
THIRD ASSISTANT ENGINEER

TO act as assistant to the Operation and Maintenance Engineer. Candidates should have qualifications which will lead to Corporate Membership of the I.E.E. and be familiar with the Operation and Maintenance of all high voltage equipment including overhead lines.

Salary: Class AX/DX, Grade 6, £925/£1,140 per annum. Sick pay and superannuation schemes in operation.

Applications giving age, details of experience, present position, etc., should be sent to the Personnel Officer, Central Electricity Hse, Lower Ham Rd, Kingston upon Thames, Surrey, to arrive by 5 May, 1960.

W. H. DUNKLEY,
Divisional Controller.
(P 659)

THE SOUTH WALES ELECTRICITY BOARD

SENIOR ARCHITECTURAL DRAUGHTSMAN

APPLICATIONS are invited for the position of Senior Architectural Draughtsman in the Chief Engineer's Department at Head Office, St. Mellons.

The salary for the position will be in accordance with Schedule D, Grade 5 (£790/£890), of the National Joint Board Agreement for the Electricity Supply Industry, and applicants will be expected to have obtained, or be studying for, membership of the R.I.B.A.

Applications stating age, present position, present salary, qualifications and experience should be addressed to the undersigned at St. Mellons, Cardiff, so as to reach him not later than Saturday, 14 May, 1960.

Envelopes should be marked "Senior Architectural Draughtsman—20/60."

R. G. WILLIAMS,
Secretary.
(P 678)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Clyde Area

(1) THIRD ASSISTANT ENGINEER
(PROTECTION AND TEST—AREA H.Q.)

(2) THIRD ASSISTANT ENGINEER
(GREENOCK DISTRICT)

(3) FOURTH ASSISTANT ENGINEER
(PLANNING AND DEVELOPMENT—AREA H.Q.)

APPLICATIONS are invited for the above appointments.

Applicants should have a good experience of both H.V. and L.V. underground and overhead distribution systems including switchgear and be members of the Institution of Electrical Engineers or hold equivalent qualifications.

The conditions of employment will be in accordance with the National Joint Board Agreement for the Electricity Supply Industry and the salaries in terms of the Agreement, viz.:

(1) Class K, Grade 10, £965/£1,025 per annum.

(2) Class F, Grade 9, £815/£860 per annum.

(3) Class K, Grade 13, £815/£860 per annum.

Applications on the standard form obtainable from this Office should be sent to the undersigned within 14 days of the appearance of this notice.

H. B. BRUCE,
Manager.

P.O. Box 15,
206 St. Vincent St,
Glasgow.
7 April, 1960. (P 662)

ADMINISTRATIVE COUNTY OF LEICESTER

ASSISTANT ELECTRICAL ENGINEER, £780/£1,070 according to qualifications. Candidates should be in possession of the Higher National Certificate in Electrical Engineering and be capable of preparing schemes for electrical installations in all types of buildings.

Lodging allowance and removal expenses may be paid to married men.

Apply to County Architect, 123 London Rd, Leicester. (P 625)

SOUTH OF SCOTLAND ELECTRICITY BOARD

Fife Area

SECOND ASSISTANT DISTRICT ENGINEER
EASTERN DISTRICT

APPLICATIONS are invited from Engineers with a wide experience of general distribution and technical training up to Higher National Certificate standard, for the above post, based on Cupar.

National Joint Board conditions; Salary: Class F, Grade 7, £910/£955 per annum; post superannuable, subject to satisfactory evidence of health.

Applications, on standard form, obtainable from the Area Manager, S.S.E.B., East Port, Dunfermline, should be returned to him not later than 29 April, 1960. (P 683)

THE NORTH WESTERN ELECTRICITY BOARD

SECOND ASSISTANT DISTRICT ENGINEER
NORTH WEST DISTRICT, ECCLES

THE duties will include the supervision of the erection and maintenance of substation switchgear, laying and jointing of cables, and switching operations on the H.V. and L.V. systems within the District as required. Applicants should have had a wide general experience on the distribution side of electricity supply and be prepared to undertake standby duties. Corporate Membership of the Institution of Electrical Engineers will be an advantage.

Salary Scale: £965 x £20—£1,025 p.a. Grade G.7. N.J.B. Conditions.

Application forms to be obtained from the Manager (Staff Vacancies), No. 1 Sub-Area, The North Western Electricity Board, Town Hall, Manchester, and returned to him by 2 May, 1960. (P 682)

YORKSHIRE ELECTRICITY BOARD

No. 4 (Leeds) Sub-Area

SUB-AREA ACCOUNTANT

APPLICATIONS are invited from qualified accountants for the position of Sub-Area Accountant. Candidates should have had wide experience of financial administration and have a knowledge of current developments in machine accounting.

Salary: N.J.M. Class C, Grade 5, £1,940/£2,140 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 4 (Leeds) Sub-Area, Yorkshire Electricity Board, Bramhope, Nr. Leeds, not later than 9 May, 1960.

No. 6 (Hull) Sub-Area

GOOLE DISTRICT
ASSISTANT CONSUMERS' ENGINEER

Applicants should have had a sound technical training and be capable of carrying out negotiations with consumers for new and additional supplies, preparing electrical schemes and specifications, and advising on the utilisation of electricity generally.

Candidates must hold at least the Ordinary National Certificate in Electrical Engineering, or equivalent qualifications.

Salary: N.J.B. Class E, Grade 9, £765 x £15—£810 per annum.

Applications, giving full details of age, qualifications and experience, together with the names of two referees, should be forwarded to the Manager, No. 6 (Hull) Sub-Area, Yorkshire Electricity Board, Ferensway, Hull, not later than 6 May, 1960. (P 666)

CENTRAL ELECTRICITY GENERATING BOARD
South Western Division

GENERAL ASSISTANT ENGINEER (EFFICIENCY)

REQUIRED at Portishead "A" Power Station.

Superannuation Scheme. Salary, N.J.B. Class J, Grade 13, £765/£810 per annum.

Preference will be given to candidates who hold or are at present studying for a Higher National Certificate or similar qualification.

Applications on Form A.E.6/ACT obtainable from the Divisional Secretary, 26 Oakfield Rd, Bristol 8, should be completed and returned by 30 April, 1960. Please quote Vacancy SW/AV/48/60. (P 671)

THE SOUTH WALES ELECTRICITY BOARD

APPLICATIONS are invited for the following positions within the Board:

(i) ASSISTANT ENGINEER

in the Pembrokeshire District (Withybush) of the West Wales Area of the Board.

Salary: N.J.B. E.9 (£765/£810).

Applications stating age, present position, present salary, qualifications and experience should be sent to W. E. Richardson, A.M.I.E.E., Manager, West Wales Area, South Beach Pavilion, Tenby, Pembs, so as to arrive not later than Saturday, 14 May, 1960. Envelopes should be marked "Assistant Engineer—80/60."

(ii) ASSISTANT ENGINEER

in the Neath District of the Swansea and West Central Area of the Board.

Salary: N.J.B. F.11 (£710/£755).

Applications stating age, present position, present salary, qualifications and experience should be sent to G. R. T. Edwards, B.SC., M.I.E.E., M.AM.I.E.E., Manager, Swansea and West Central Area, 29 Ystrad Rd, Swansea Industrial Estate, Swansea, Glam, so as to arrive not later than Saturday, 14 May, 1960. Envelopes should be marked "Assistant Engineer—81/60."

(iii) ASSISTANT ENGINEER

in the Bridgend District (Waterton Depot) of the Cardiff and East Central Area of the Board.

Salary: N.J.B. F.9 (£815/£860).

Envelopes should be marked "Assistant Engineer—82/60."

(iv) (a) ASSISTANT COMMERCIAL ENGINEER
and
(b) ASSISTANT ENGINEER

in the Pontypridd District of the Cardiff and East Central Area.

Salary for both positions: N.J.B. F.9 (£815/£860).

Envelopes should be marked "Assistant Commercial Engineer—83/60(a)," or "Assistant Engineer—83/60(b)."

(v) ASSISTANT COMMERCIAL ENGINEER

in the Rhondda District of the Cardiff and East Central Area.

Salary: N.J.B. F.9 (£815/£860).

Envelopes should be marked "Assistant Commercial Engineer—68/60."

Applications stating age, present position, present salary, qualifications and experience should be sent to C. L. Townsend, ASSOCIATE I.E.E., Manager, Cardiff and East Central Area, 445/447 Cowbridge Rd East, Cardiff, so as to arrive not later than Saturday, 14 May, 1960.

R. G. WILLIAMS,
Secretary.
(P 677)

SOUTH EASTERN ELECTRICITY BOARD

ASSISTANT DISTRICT ENGINEER

WOKING district, Class F, Grade 7, under N.J.B. Agreement. Salary: £910 x £15—£955 per annum. Superannuable. Applicants, who should have had a good general education and be technically trained up to H.N.C. standard, must have had practical training and experience in general distribution work on systems up to 11 kV and be capable of organising and supervising the work of a full construction and maintenance programme. Ability to plan and prepare schemes for mains extensions would be an advantage. Subject to certain conditions, Board owned accommodation may be available within the district. Applications, quoting ET and naming two referees on forms from District Manager, Seeboard, 4 Chobham Rd, Woking, by 4 May, 1960.

GEORGE WRAY,
Secretary.
(P 655)

CENTRAL ELECTRICITY GENERATING BOARD
North Eastern and Yorkshire Region

SKELTON GRANGE "B" POWER STATION

APPLICATIONS are invited for the following appointments at Skelton Grange "B" Power Station, near Leeds.

MAINTENANCE ENGINEER (MECHANICAL)
MAINTENANCE ENGINEER (ELECTRICAL)

Applicants should have experience in the maintenance of modern power stations and should possess good technical qualifications.

The salary for both appointments will be in accordance with the National Joint Board Agreement, Schedule A, Grade 5, Class L (£1,470/£1,575 per annum).

Forms of application may be obtained from the Assistant Regional Secretary (Personnel), Central Electricity Generating Board, North Eastern and Yorkshire Region, 1 Whitehall Rd Leeds 1, to whom they should be returned to arrive not later than 2 May, 1960. (P 681)

ADEN GOVERNMENT

INSPECTOR OF WORKS (ELECTRICAL)

REQUIRED on contract for one tour of 18/24 months in first instance. Salary according to age and experience in scale (including pay differential) £1,040 rising to £1,479 a year. Gratuity at rate 12½% of total salary drawn. Outfit allowance £60. Free passages.

Candidates, under 55 years of age, must have served electrical apprenticeship and had seven years' subsequent experience, half of which spent in supervisory capacity. Knowledge of rewiring motors, air conditioning and maintenance of installations an advantage. Write to the Crown Agents, 4 Millbank, London S.W.1. State age, name in block letters, qualifications and experience and quote M2A/51007/EE. (P 679)

MIDLANDS ELECTRICITY BOARD

APPLICATIONS are invited for the following superannuable posts:

Birmingham & District Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER (NORTH WEST DISTRICT)

Experience necessary in the construction, operation and maintenance of large H.V. and M.V. underground and overhead distribution systems. Technical qualifications desirable. Salary: £965/£1,025 per annum (N.J.B. Grade J.9). Apply, by letter, within 14 days, stating age, experience, present position and salary to Emil Braathen, Sub-Area Manager, Midlands Electricity Board, 14 Dale End, Birmingham 4.

Board Headquarters, Halesowen

THIRD ASSISTANT ENGINEER (PLANNING) (CHIEF ENGINEER'S DEPARTMENT)

Duties will include the planning of medium voltage and high voltage networks, load flow and fault level studies and load estimates. Salary within the range £925/£1,170 per annum, according to qualifications and experience (N.J.B. Schedule B, Grade 6 AX/EX). Apply, by letter, within

continued in next column

continued from previous column

14 days, stating age, experience, present salary and position to The Secretary, Midlands Electricity Board, Mucklow Hill, Halesowen, nr. Birmingham.

Wolverhampton & District Sub-Area

THIRD ASSISTANT DISTRICT ENGINEER (WOLVERHAMPTON)

Duties will include the construction, maintenance and operation of H.V. and L.V. underground mains, overhead lines and substations and the planning of system reinforcements and mains extensions. Technical qualifications desirable. Salary: £965/£1,025 per annum (N.J.B. Grade J.9). Apply, by letter, within 14 days, stating age, experience, present position and salary to Mr D. Holt, Sub-Area Manager, Midlands Electricity Board, 83 Darlington St, Wolverhampton.

Worcester & District Sub-Area

SENIOR DRAUGHTSMAN (REDDITCH/BROMSGROVE)

The successful applicant will be required to take charge of the Drawing Office. Applicants should have had a sound technical education and experience in the preparation of engineering drawings, substation design, and layout plans, keeping of permanent mains records, and general Drawing Office routine. Salary: £790/£890 per annum (N.J.B. Schedule D, Grade 5). Apply, by letter, within 14 days, stating age, experience, present position and salary to District Manager, Midlands Electricity Board, Windsor Rd, Redditch.

F. W. CATER,
Secretary.
(P 685)

MERSEYSIDE AND NORTH WALES ELECTRICITY BOARD

SENIOR SALES REPRESENTATIVE

REQUIRED in the North Wirral District, Craven Street, Birkenhead. Salary within range £720/£780 per annum (N.J.C. Grade 3).

Candidates should have a good knowledge of electrical appliances and the direction of a sales organisation.

Appointment subject to medical examination. Pension scheme.

Applications, on forms obtainable from the Manager, No. 3 Sub-Area, Electricity Hse, Newgate St, Chester, should be returned not later than 4 May, 1960.

(P 693)

CENTRAL ELECTRICITY GENERATING BOARD
Eastern Division

APPLICATIONS are invited for the following appointment:

THIRD ASSISTANT ENGINEER (CIVIL AND MECHANICAL)
DIVISIONAL ELECTRICAL DEPARTMENT (DESIGN AND CONSTRUCTION SECTION)
DIVISIONAL HEADQUARTERS COCKFOSTERS

Salary N.J.B., Class AX/DX, Grade 5, £1,090 x £25—£1,215/£1,320 per annum plus London Weighting.

The successful applicant will be required to supervise contractors in the construction of civil engineering works for transmission substations.

Applicants should have received training in civil and/or mechanical engineering and have experience in the construction of substations, and should preferably intend to qualify for Associate membership of one of the Institutions of Civil, Mechanical or Electrical Engineers.

Experience in the construction of transmission lines on steel towers would be an advantage.

Apply by 7 May, 1960, quoting Staff Vacancy No. 1319, giving age, details of qualifications and experience to the Controller, Central Electricity Generating Board, Eastern Division, West Farm Pl, Chalk La, Cockfosters, Barnet, Herts.

(P 692)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
ELECTRICAL DEPARTMENT
APPOINTMENT OF ASSISTANT CIVIL ENGINEER

APPLICATIONS are invited for the position of Assistant Civil Engineer in the Electrical Department at Divisional Headquarters for work in connection with the construction of high voltage substations.

Applicants should have technical qualifications equivalent to those required for corporate membership of the Institution of Civil Engineers. Some experience of the design and construction of foundations, reinforced concrete structures, buildings, roads and drainage, is necessary, and applicants should be capable of carrying out simple ground surveys. A working knowledge of the measurement of engineering quantities would be an advantage.

N.J.B. Agreement Conditions. Superannuable appointment. Salary within Schedule B, either Grade 6 (£925 x £25—£1,050 rising to £1,170 per annum) or Grade 7 (£840 x £25—£965 rising to £1,065 per annum). Grade and commencing incremental stage according to qualifications and experience.

Apply, quoting reference No. 74/60MD, on form AE6, available from the Divisional Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, not later than 13 May, 1960. (P 689)

SOUTH OF SCOTLAND ELECTRICITY BOARD
Stirling Area
SECOND ASSISTANT DISTRIBUTION ENGINEER
(Vacancy Ref. No. 29/60.)

REQUIRED for the Bathgate District of this Area. National Joint Board conditions. Salary: Class F, Grade 7, £910/£955 per annum. Post superannuable.

Training and experience as an Engineer in electricity supply work essential and possession of a Higher National Certificate in Electrical Engineering (or equivalent) desirable.

Applications are to be submitted on the standard form, obtainable at this address, not later than 2 May, 1960.

JAMES G. CURTIS,
Manager.

"Woodlands,"
St. Ninians Rd,
Stirling. (P 687)

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION
TECHNICAL ASSISTANT

THE Commission requires a qualified Engineer for a new post of Technical Assistant to the Chief Engineer at the Head Office of the Commission in Port-of-Spain.

Applicants must be graduate members of either the I.E.E. or the I.Mech.E., or hold a Higher National Certificate or a University Degree in either Electrical or Mechanical Engineering. They must have had some experience in the construction and operation of steam power stations.

The successful candidate will investigate and prepare reports for the Chief Engineer and generally act as his Personal Assistant on all Engineering matters. He will also supervise a small drawing office.

The commencing salary is £1,627 10s rising to £1,732 10s per annum.

Housing: A partly furnished house will be provided at a rental of £10 8s 4d a month, plus a small extra charge for heavy furniture.

Leave: 45 days annual leave is granted each year. 14 days of this must be taken locally and the balance can be accumulated for overseas leave after three (3) years.

Passages: First Class passages will be provided for the successful applicant and his wife and also for children up to the age of 18 up to a maximum cost of two adult passages for three children. Leave passages are provided after three (3) years' service.

Outfit Allowance: A £60 outfit allowance will be paid on arrival in Trinidad.

Car Allowance: A car allowance for necessary mileage is paid and an interest-free load advanced for the purchase of a car.

Information on Trinidad can be obtained

continued in next column

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from the West India Committee 40 Norfolk St, London W.C.2.

Applications giving full details of qualifications, age and experience, together with two recent testimonials, should reach the General Manager, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, West Indies, on or before the 31 May, 1960. (P 691)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
ASSISTANT ENGINEER (DISTRICTS)

FOURTH ASSISTANT ENGINEERS are required in the Meaford, Bushbury, Birmingham and Stourport Districts of the Electrical Department.

N.J.B. Agreement Conditions: Superannuable Appointments. Salary within Schedule B, either Grade 8 (£735 x £25—£860 rising to £960 per annum) or Grade 7 £840 x £25—£965/£1,065 p.a.). Grade and commencing incremental stage according to qualifications and experience.

Candidates should possess a Higher National Certificate in Electrical Engineering, or an equivalent qualification, and should preferably have had some experience on any type of equipment associated with E.H.V. transmission. The selected applicants may be required initially to exchange duties for a short period between the District and Divisional Headquarters. Applicants should state if they have a preference for any particular district.

Apply, quoting Reference No. 76/60MD, on Form AE6, available from the Divisional Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13, not later than 13 May, 1960. (P 690)

CENTRAL ELECTRICITY GENERATING BOARD
Midlands Division
ELECTRICAL DEPARTMENT
APPOINTMENT OF ASSISTANT ENGINEER TRANSMISSION CIRCUIT CONSTRUCTION

APPLICATIONS are invited for the position of Assistant Engineer—Transmission Circuit Construction, in the Electrical Department at Divisional Headquarters for work in connection with the installation of high voltage overhead transmission lines and underground cables.

Applicants should have technical qualifications equivalent to those required for corporate membership of the I.E.E.

Some experience in the construction and installation of 132 kV or 275 kV steel tower overhead transmission lines is necessary, together with a knowledge of route surveying and preparation of profiles. Experience in the laying and jointing of E.H.T. cables would be an advantage.

continued in next column

continued from previous column

N.J.B. Agreement Conditions. Superannuable Appointment. Salary within Schedule B, either Grade 6 (£925 x £25—£1,050 rising to £1,170 per annum), or Grade 7 (£840 x £25—£965 rising to £1,065 per annum). Grade and commencing incremental stage according to qualifications and experience.

Apply quoting Reference No. 75/60MD, on Form AE6, available from the Divisional Establishments Officer, 53 Wake Green Rd, Moseley, Birmingham 13 not later than 13 May, 1960. (P 688)

TECHNICAL REPRESENTATIVE, age 30-40, resident Midlands area, for manufacturers of Constructional Angle, Cable Tray Plate and Cable Trunking, must have knowledge of the Mechanical and Electrical Engineering Trades. Attractive salary, compulsory pension scheme, expenses and car provided. Applications in writing stating education, positions held, age and present salary to Sales Manager, Box No. 7825, Electrical Times. (P 644)

CHIEF ENGINEER

to be responsible to Technical Director for research, design and development of

ELECTRICAL GENERATING PLANT and CONTROL GEAR

Our firmly established products currently range up to 450 kVA for applications in aviation and industry which demand performance and precision of very high order. Electronic equipment of advanced design is developed, manufactured and incorporated very successfully.

Chartered Electrical Engineers of up to 45 years are invited to submit applications for this new appointment. Enthusiasm is a prerequisite, as is proven ability to co-ordinate work of team numbering 40 upwards. Experience in standardisation and simplification programmes will be particularly appropriate.

Our expanding product-range offers impressive challenge and corresponding opportunity; we seek only top-flight ability and expect to reward it accordingly. Other benefits commensurate.

Technical Director will appraise all applications and completely confidential treatment is assured.

VERNONS INDUSTRIES LIMITED,
Kirkby Industrial Estate,
LIVERPOOL
(P 684)

Vacancies exist at an integrated Iron and Steelworks in North Lincolnshire for:

THREE
PLANT ELECTRICAL ENGINEERS

The successful candidates who will have control of a Section of the Electrical Department in either the Rolling Mill, Blast Furnaces or Power and Main Distribution System, will initially assist with electrical development and the installation and commissioning of new plant.

Applicants aged 25-45, should be at least Graduate Members of the Institute of Electrical Engineers and should preferably have had experience in steelworks or electrical manufacture. They should also have had supervisory experience in large scale electrical maintenance.

Application forms are available from:

The Manager,
Staff and Labour Relations Department,
Richard Thomas and Baldwins Ltd.,
Redbourn Works, Scunthorpe, Lincolnshire,

and should be returned by 6 May, 1960. (P 674)

NEW ZEALAND

MINISTRY OF WORKS

The New Zealand Government Ministry of Works invites applications for Permanent Staff appointments. Positions available are:

CIVIL ENGINEERS

Qualifications: Corporate membership of the Institution of Civil Engineers, London. Commencing salaries from £955/£1,525 p.a.

ASSISTANT CIVIL ENGINEERS

Qualifications: A University Degree in Civil Engineering which gives exemption from Final Parts I and II of the A.M.I.C.E. examination; or other qualifications exempting from Parts I and II of A.M.I.C.E., plus at least five years' appropriate experience. Commencing salaries from £870/£1,060 p.a.

MECHANICAL AND ELECTRICAL ENGINEERS (AND ASSISTANTS)

Qualifications: Corporate membership of the Institutions of Mechanical or Electrical Engineers, London, or for Assistants a University Degree in Mechanical or Electrical Engineering or Graduate Membership of the above Institutions. Commencing salaries, depending on experience, for Engineers £955/£1,525 and for Assistants up to £1,060 p.a.

BUILDING SERVICES ENGINEERS (AND ASSISTANTS)

Qualifications: Corporate membership of the Institution of Mechanical Engineers or of the Institution of Heating and Ventilating Engineers, London, or for Assistants, a University degree in mechanical engineering or Graduate membership of the above Institutions. Commencing salaries, depending on experience, for Engineers £955/£1,525 p.a. and for Assistants up to £1,060 p.a.

DRAUGHTSMEN—CIVIL AND STRUCTURAL

Qualifications: Ordinary or Higher National Certificates or the final examination of the City and Guilds, London, or Associate Membership of the Institution of Structural Engineers are desirable, but primary requirement is for skilled and speedy draughtsmen with substantial experience at the drawing board and in the types of civil engineering work designed by the Ministry of Works. Commencing salary up to £1,060 p.a.

DRAUGHTSMEN—MECHANICAL, ELECTRICAL AND BUILDING SERVICES

Qualifications: Ordinary or Higher National Certificate in Mechanical or Electrical Engineering or equivalent examination, and at least three years' experience in draughting, design and calculations. Commencing salaries up to £1,060 p.a.

QUANTITY SURVEYORS AND ASSISTANT QUANTITY SURVEYORS

Qualifications: Quantity Surveyors must be Associates of the Royal Institute of Chartered Surveyors or the Quantity Surveyors' Institute. Assistant Quantity Surveyors should have passed the intermediate sections of those examinations.

For both positions experience is required in the measuring and pricing of the building and allied trades, in final accounts and adjustment of contracts.

Commencing salaries up to £1,285 for Quantity Surveyors and up to £1,060 for Assistants.

Enquiries, mentioning this publication, quoting reference number B11/30/22 and indicating the position sought, should be addressed to the High Commissioner for New Zealand, 415 Strand, London W.C.2. Full details of housing available, fares payable, career prospects, type of work, terms of contract, local conditions and application forms will then be supplied.

(P 668)

M.K. ELECTRIC LIMITED

require

SENIOR DESIGNER/DRAUGHTSMEN

for development work on electric wiring accessories and the like. Previous experience in this specialised field, together with a good knowledge of modern methods of quantity production, are essential. A substantial salary will be offered to suitable applicants. Applications in writing stating age, education and previous experience will be treated in strict confidence, and also acknowledged, if addressed to 'D.G.M.,' M.K. Electric Ltd., Shrubbery Rd, Edmonton, London N.9. (P 636)

CRATER PRODUCTS LTD. Manufacturers of Rotary Switches wish to appoint a number of REPRESENTATIVES. Good connections are essential and will qualify for generous remuneration and expenses. Apply Crater Products Ltd., Knaphill, Woking. Brookwood 2571. (P 669)

WORK WANTED

A.C. and D.C. MOTOR REWINDS and REPAIRS. Prompt service, fully guaranteed. Edgware 5566 (4 lines). — Service Electric Co. Ltd., Stanmore, Middx. (P 2)

METALWORK. All types of cabinets, chassis, racks, etc., to your own specification. — Philpotts Metalworks Ltd., Chapman St, Loughborough. (P 12)

WANTED

LIFT for two floors (second-hand) wanted to take stretcher and three people. A.C.—Express Electrical Equipment, 88 Northgate, Cottingham, Yorkshire. (P 660)

WANTED for prompt cash, ferrous and non-ferrous SCRAP; also plant for dismantling. Buyers of second-hand machinery and plant for re-use.—W. and H. Cooper Ltd., 17 Brady St, Bethnal Green, E.1. (P 1)

FOR SALE

A.C. and D.C. SLOTMETERS: Time Switches and Quarterly Meters. Single and polyphase, 2½—100 amps. Tested and guaranteed 2 years. Television and Billiards Meters. — Tradex Meter Co., Surbiton. Elmbridge 2234/5/6. (P 9)

A.C. and D.C. MOTORS, GENERATORS from stock.—Service Electric Co. Ltd., Honeypot La, Stanmore, Middx. Edgware 5566/9. (P 4)

A.A. ELECTRICAL CO. for A.C.-D.C. MOTORS, switchgear, exhaust fans, hoists, reduction gears, new or reconditioned units.—Chi 5105, 67 Rothschild Rd, W.4. (P 3)

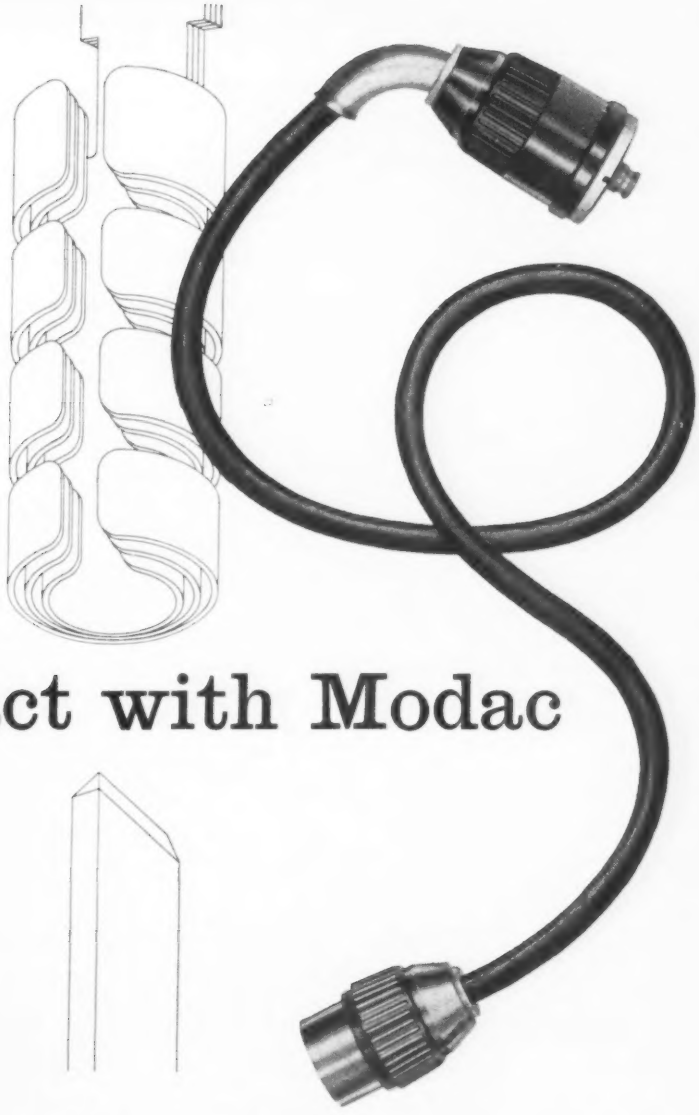
ELECTRIC MOTORS, D.C. and A.C. Motor Generator Sets, Alternators and Dynamos, Diesel Sets, Circuit Breakers, Switchboards, reconditioned and guaranteed. Very large stocks held.—Britannia Manufacturing Co. Ltd., Britannia Walk, N.1. CLErkenwell 5512-3-4. Stores at Chobham, Surrey. (P 7)

HOUSE-SERVICE METERS, all types can be obtained by return from Selectrics, Dept. E.T., Meter Hse, Factory Row, Castle Circus, Torquay. Phone 7218. (P 8)

HOUSE-SERVICE METERS, A.C. or D.C., quarterly or prepayment.—Universal Electrical, 221 City Rd, London, E.C.1. (P 5)

PURLEY CHOKES AND BALLASTS. Our 80-W tapped h.p.f. ballast with starter switchgear-holder incorporated is proving itself the most popular unit. Suitable for most fittings, 57s 6d each subject. —F. W. Blanshard Ltd. (Dept. E.T.), Purley, Surrey. Uplands 4818/9. (P 6)

SECOND-HAND Electrical Plant can be as good as new if you buy it from specialists. Write for our stock list. Dynamo and Motor Repairs Ltd., North End Rd, Wembley Pk, Middlesex. Telephone: Wembley 3121; Soho Rd, Handsworth, Birmingham. Telephone: Birmingham Northern 0898. (P 10)



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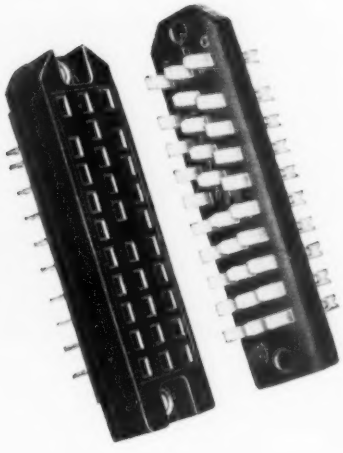

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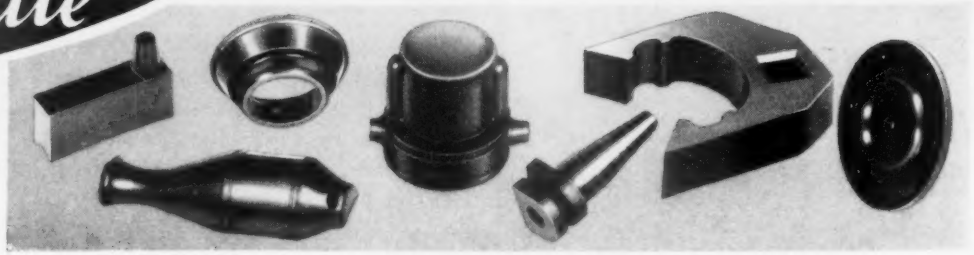

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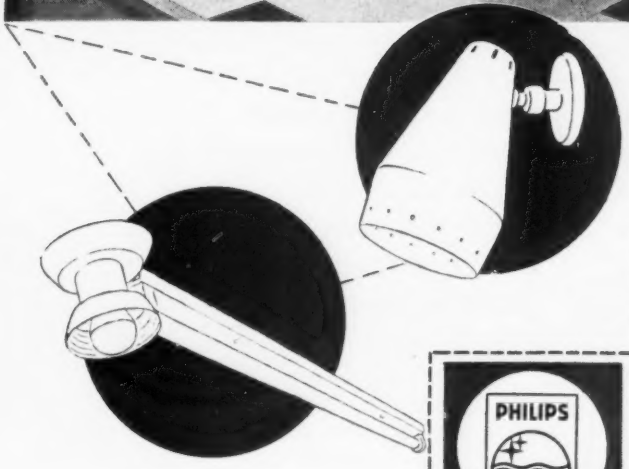

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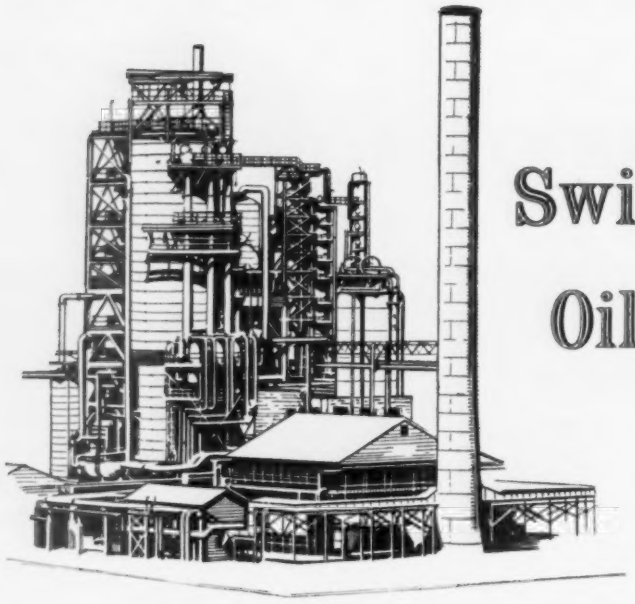

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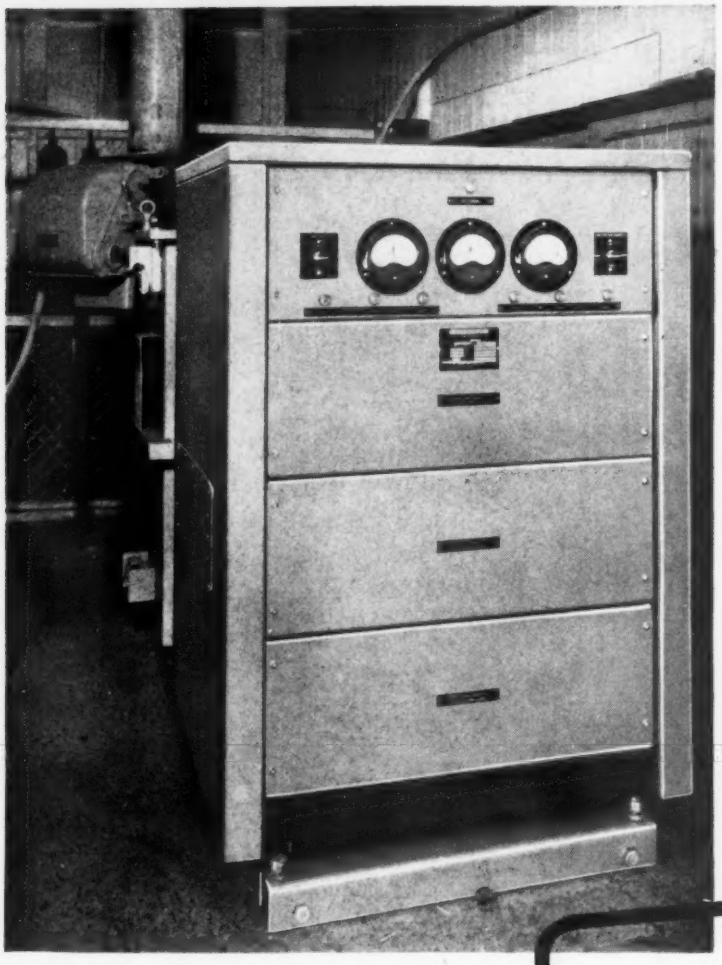

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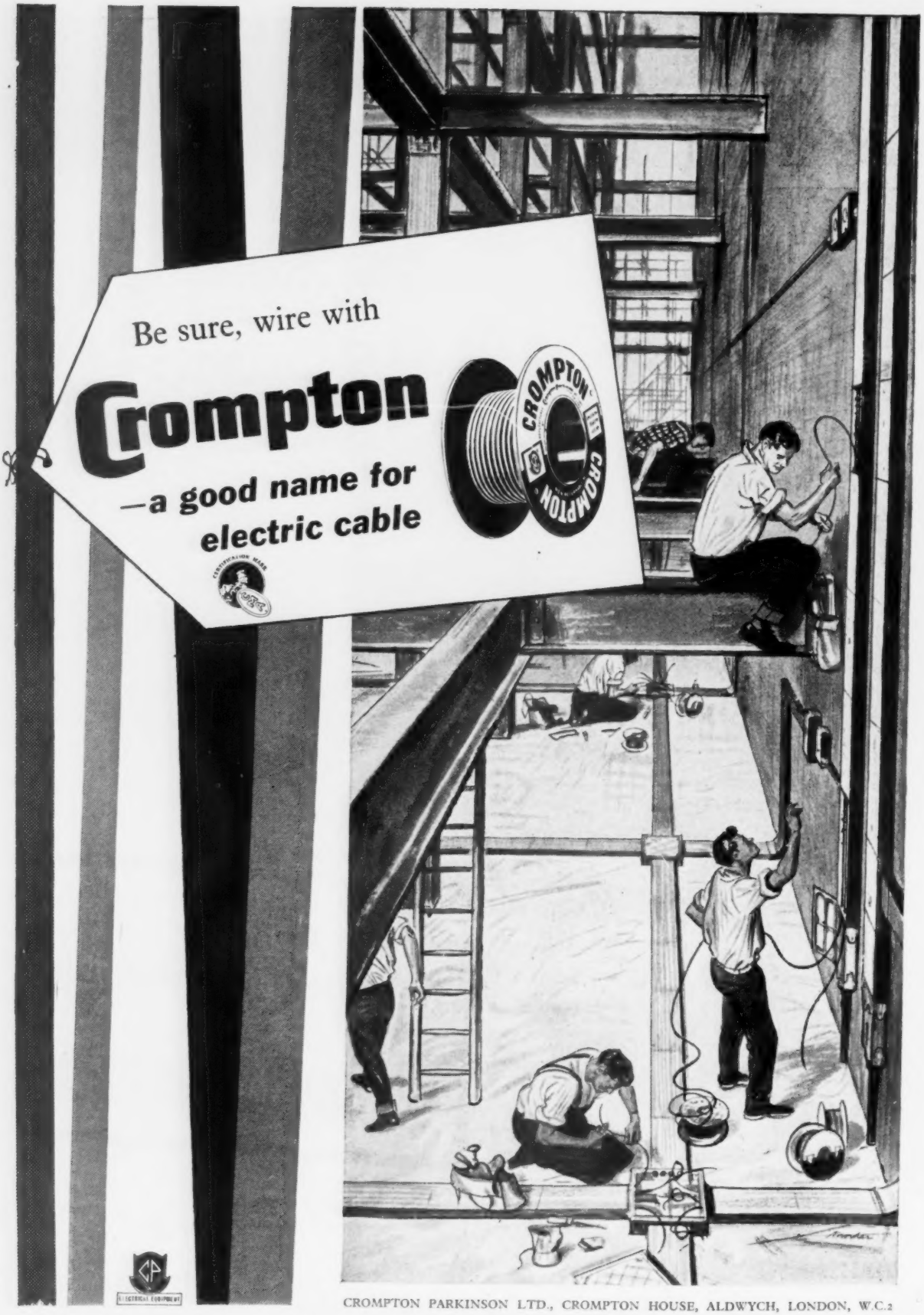

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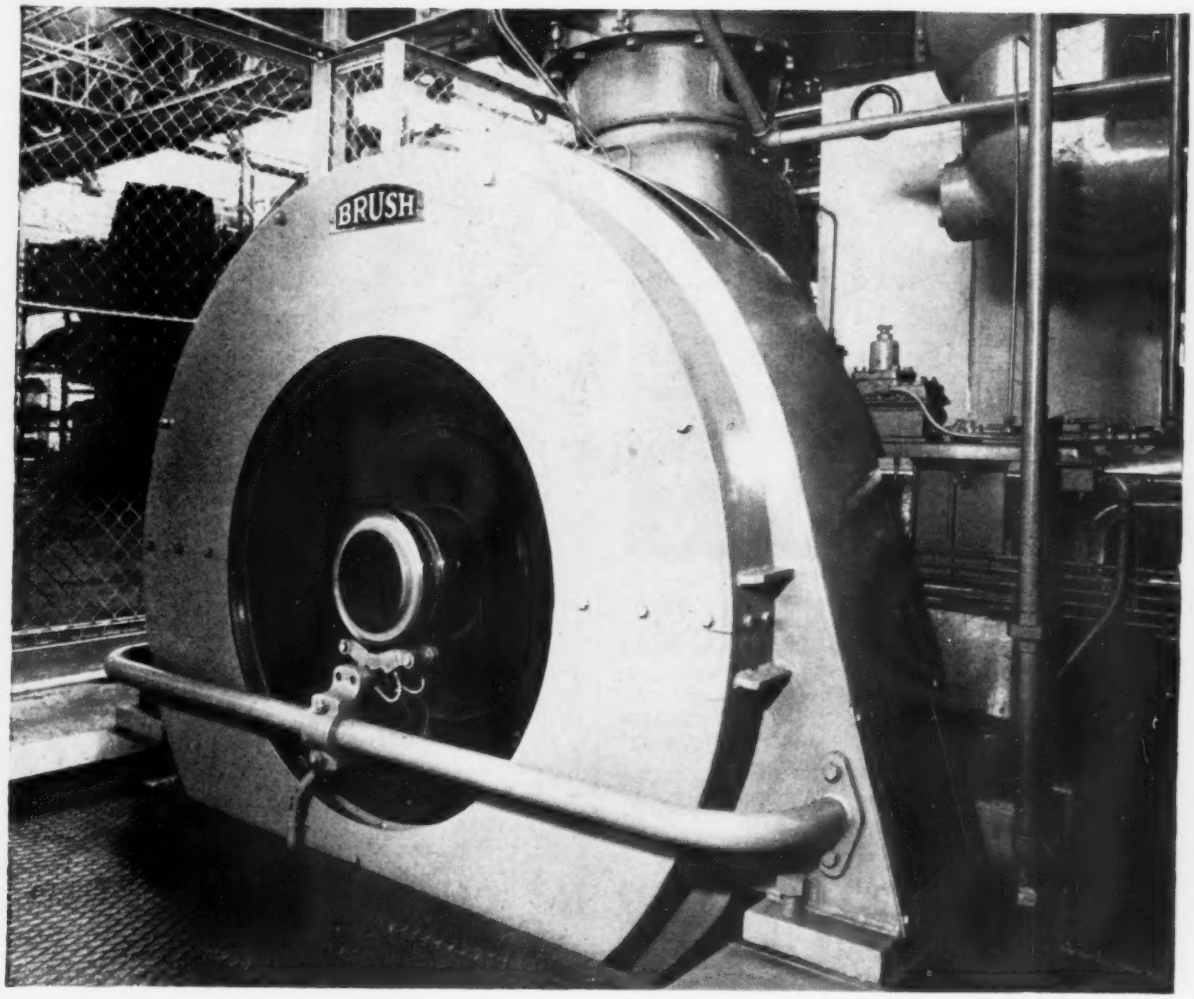

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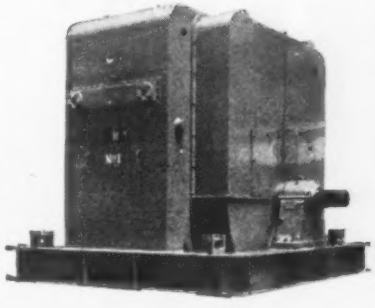

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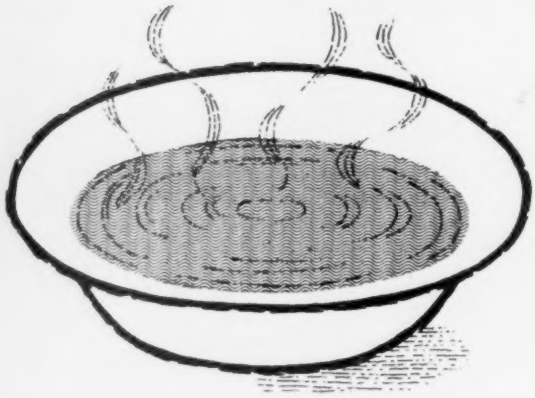

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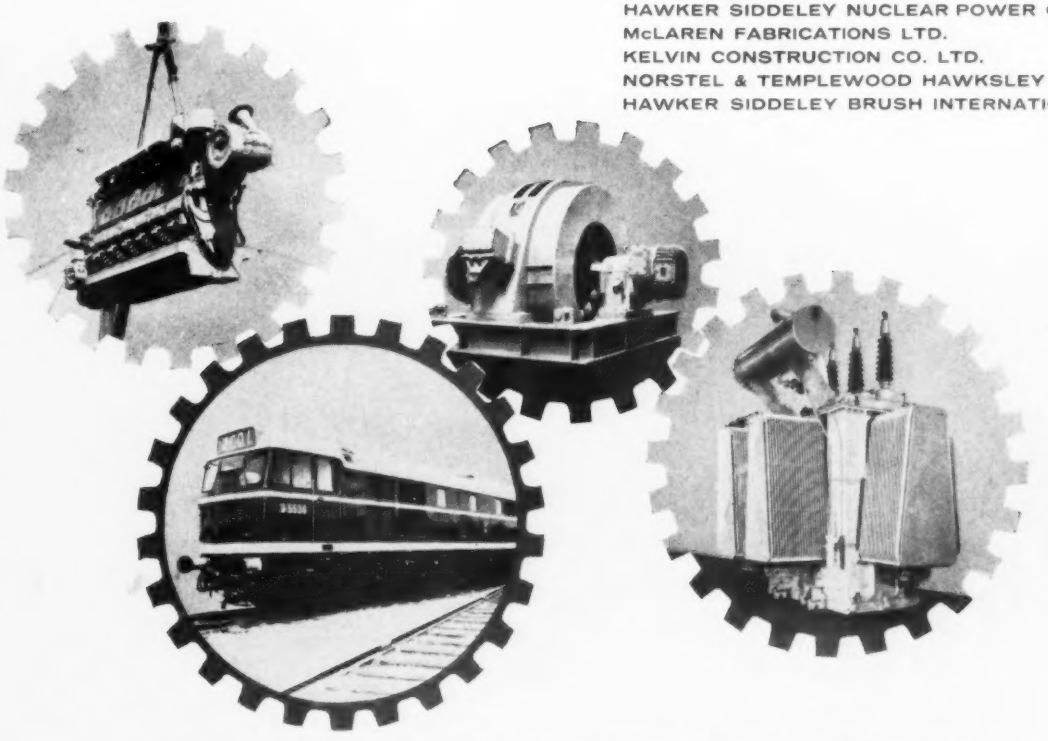

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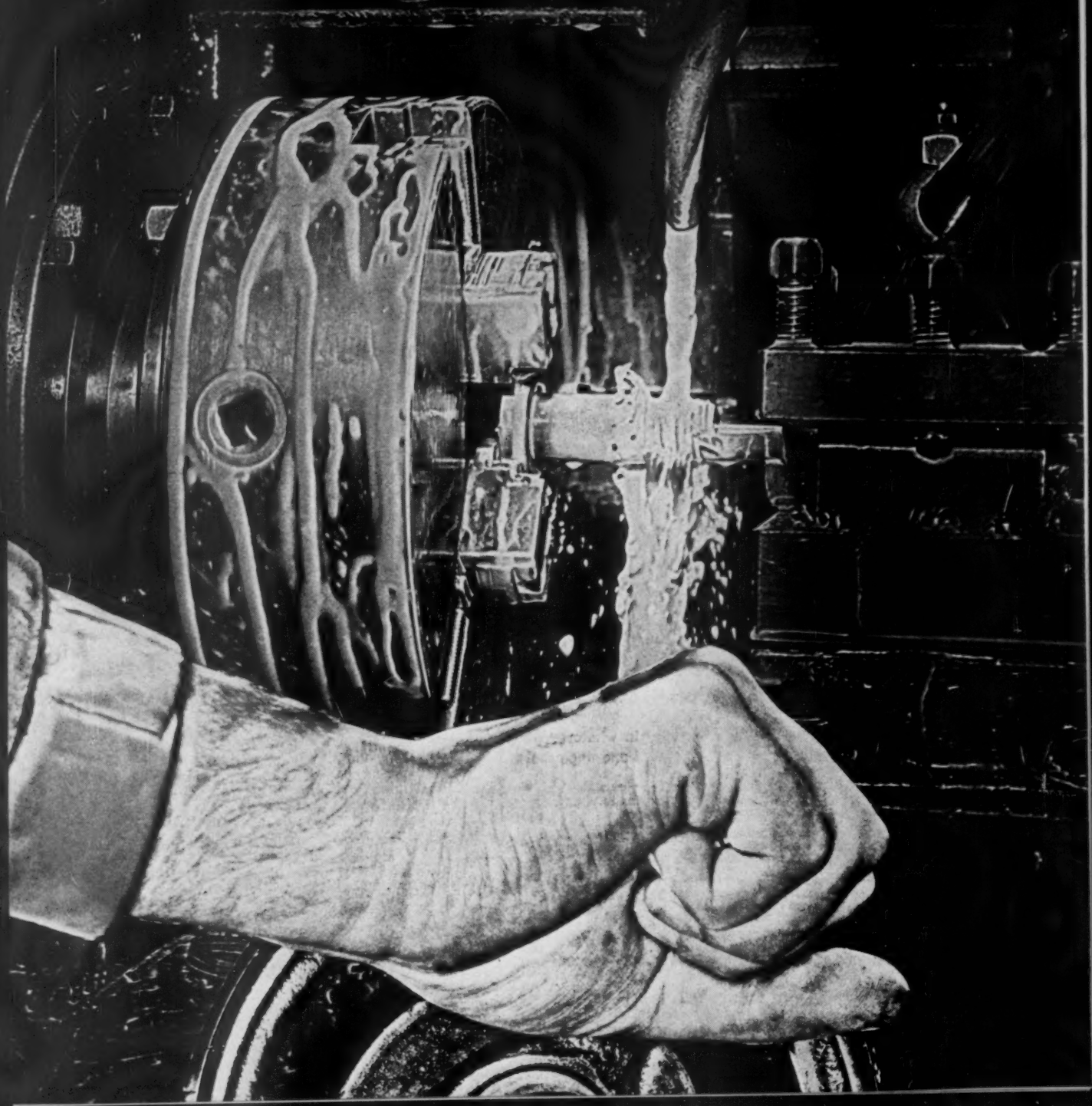


With new Shell Dromus Oils

Most modern soluble cutting oils contain phenolic compounds used as coupling agents between the oil and the emulsifier, for better blending and easier mixing. These phenolic compounds can cause skin irritation, especially where modern high-speed machines are used and the emulsion can concentrate, through the evaporation of water, above the safety level.

Shell research chemists have been working on this problem, which has been causing some concern to Management. After considerable research, Shell Dromus Oils have been reformulated and these new cutting oils now produce bland emulsions, which considerably reduce the risk of skin trouble to operators.

The real difficulty was to find a new coupling agent to replace the phenolic compounds, and Shell finally used what their chemists know as a higher fatty alcohol complex. This solved one problem, but presented another. The new coupling agent was volatile at the high temperatures normally used in blending processes. Further research found a solution to this problem by designing and installing new plant.

The new Dromus Oils are every bit as efficient as before and cost no more. They put Management in the welcome position of being able to minimise working hazards at no extra cost. And machine men need no longer be so worried about skin troubles.

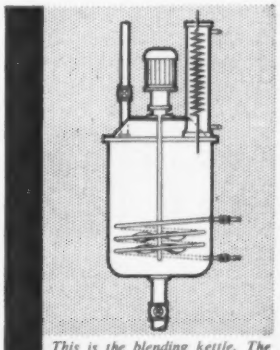
The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organization have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Shell chemists in the U.K., in Holland and in the U.S.A., prepared and examined hundreds of experimental soluble oils, and established that certain combinations of fatty alcohols could be used in place of phenolic compounds with no loss of efficiency. They set to work to discover the best combination and developed a higher fatty alcohol complex which fitted exactly. Then they realised that to blend this new coupling agent into soluble oils would require special plant and new blending techniques.

Exhaustive testing of blend stability, emulsion stability, anti-corrosion and machining properties led to selection of the most promising blends. A pilot plant was set up to produce batches of these for use in field trials.

This field testing and final development proceeded for two years whilst production plants were erected at points so chosen as to give the most economical and rapid delivery throughout the United Kingdom.



This is the blending kettle. The reflux condenser beside the stirrer motor prevents the loss of constituents volatile at the blending temperature.

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another proof of Shell leadership in lubrication

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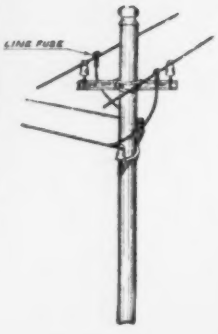

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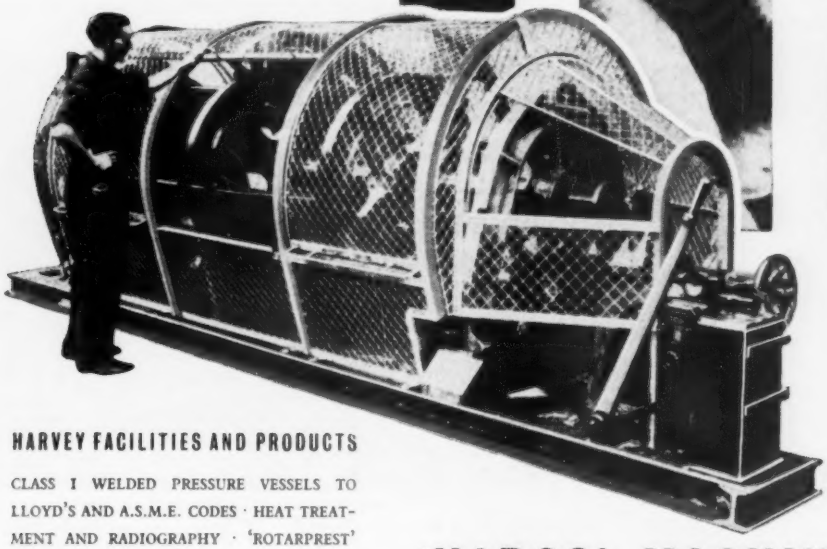

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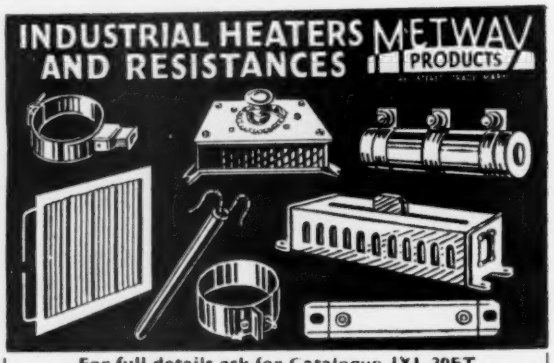

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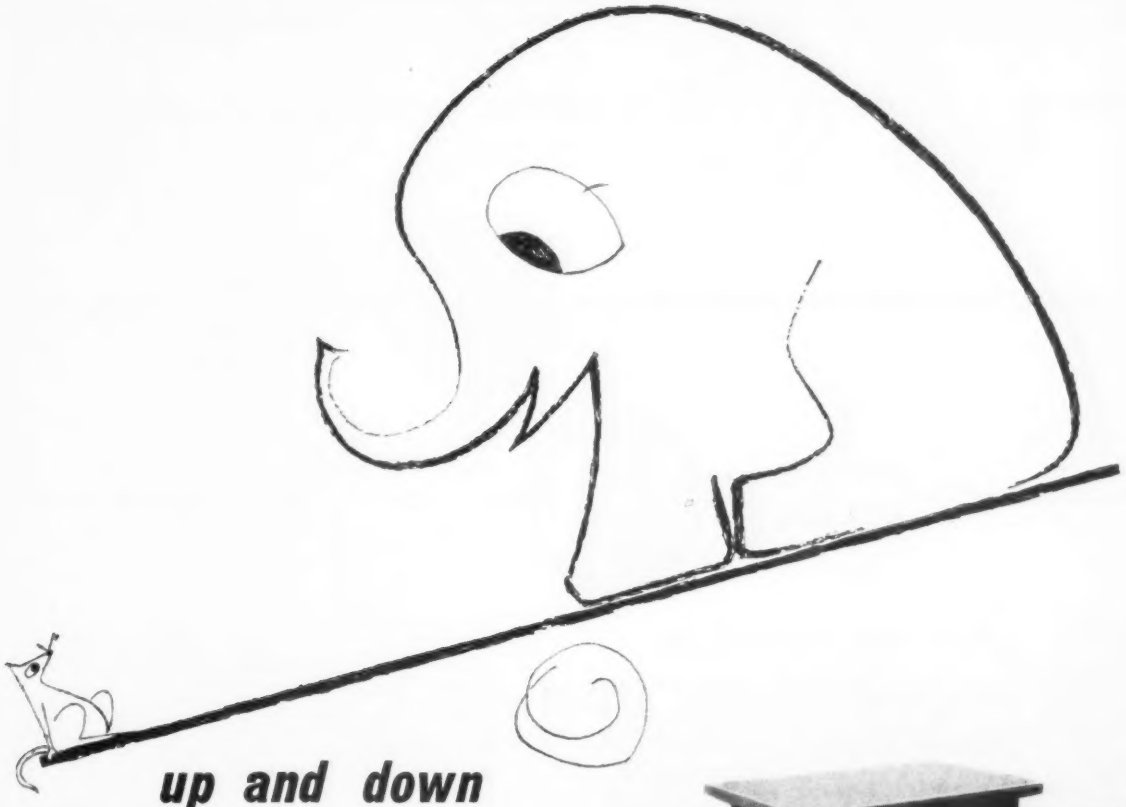

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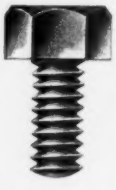

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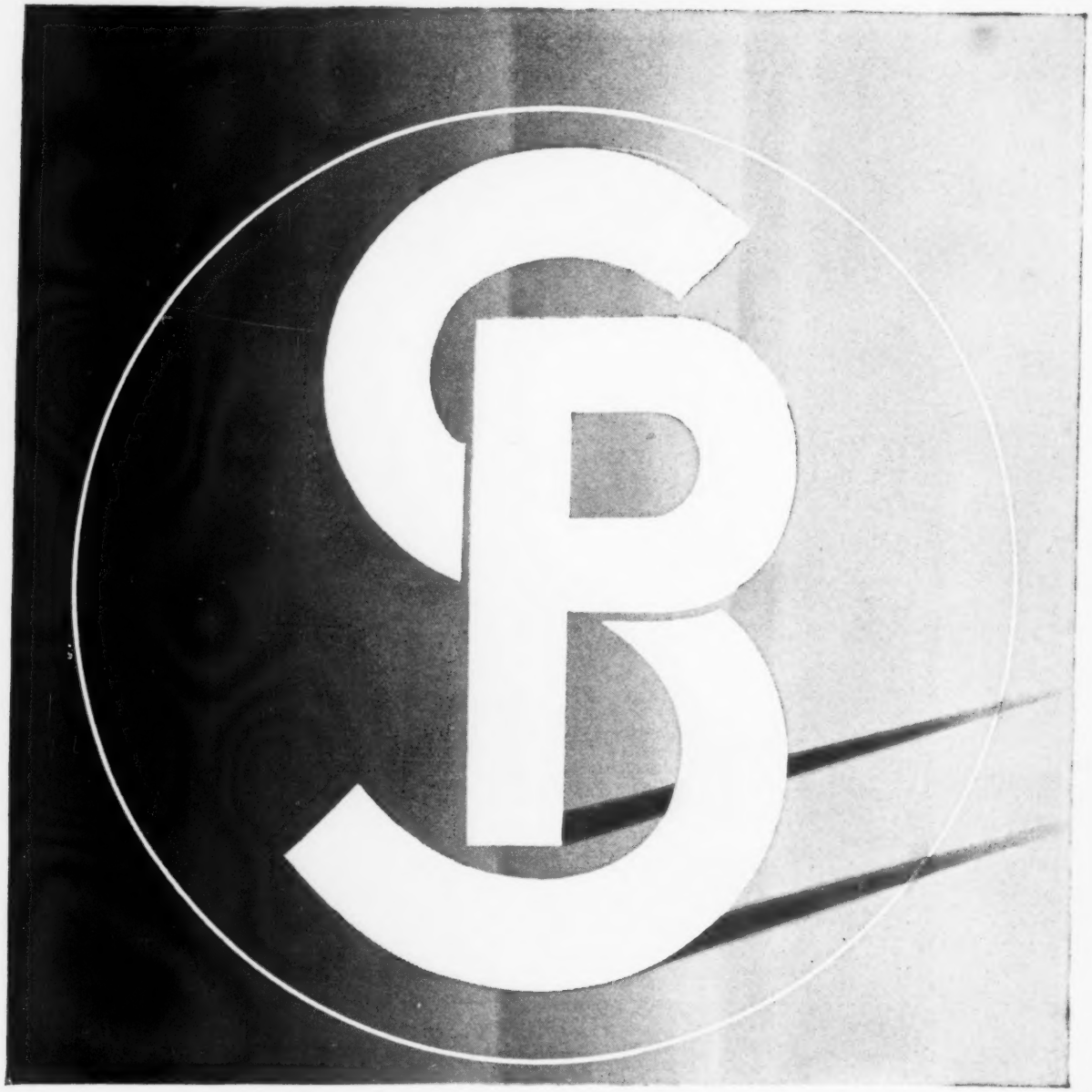

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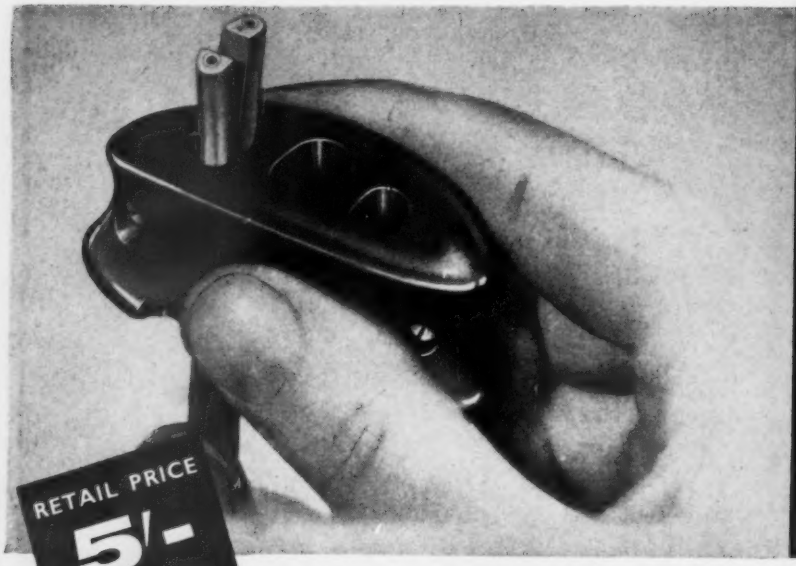

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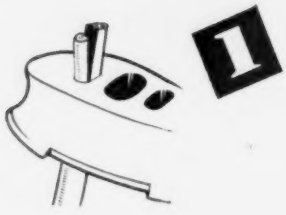

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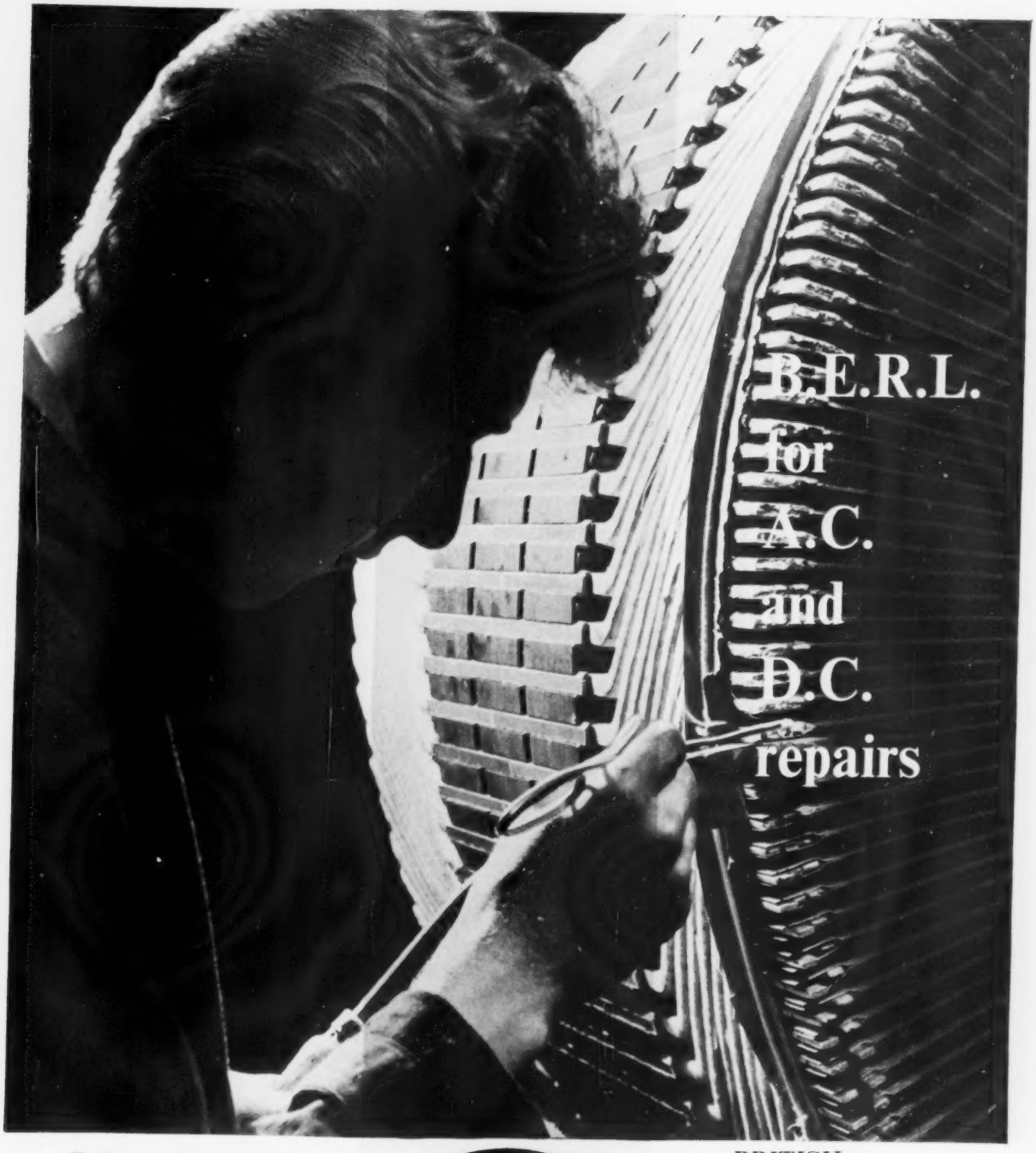

The illustration shows the soldering of the winding to commutator risers of a 1250 kW., D.C. generator armature.

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